3

A Theory of Occupational Choice

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The Problem

The study of what has frequently been called the *status attainment process* is one of the few areas of social science research which can boast a reasonably steady accumulation of knowledge. Status attainment research has been unusually productive in two fundamental ways: first, it has served as a fruitful testing ground for basic sociopsychological theory which has led to several important advances in basic attitude formation and socialization theory, particularly concerning interpersonal influence; and second, it has led to a significantly fuller and more accurate understanding of the actual processes by which statuses are allocated within and across generations. These advances are reflected partly by the steadily increasing amount of variance in aspirations and actual attainment levels which can be explained by measurable and even manipulable variables, and more importantly by more and more precisely specified causal models of the interrelated variables shown to be involved in the status attainment process. So much progress has been made, in fact, that it is now possible to predict the adult attainment levels of children with considerably better than chance accuracy on the basis of a few relatively simple measurements taken in early high school. Moreover, there is every reason to believe (contingent on adequate research funding) that this trend of progress will continue.

So far, however, this modest success has not been translated into equivalent ability to explain or predict actual job choices. While it may be possible to predict with some accuracy the amount of education or the level of income or occupational prestige a person will attain, it is not yet possible to predict the actual job a person will take as an adult with much better than chance accuracy. This remains so in spite of the belief of most researchers that the fundamental sociopsychological processes by which aspiration levels and actual job choices are formed are probably similar and perhaps even identical.

Although many significant variations can be found, most recent status attainment research has assumed on a most general level that sociostructural factors like socioeconomic status, sex, and others exercise causal influence over sociopsychological factors like the expectations held by "significant others," which in turn exert direct influence over the attitudes of the individual. These attitudes, mediated in turn by what Haller (1957) has termed *facilitational variables,* exert causal influence over later attainments. Insofar as this model is meant to account in general for the process by which *any* reasonably long-term attitudes and behaviors are established, it might well be expected to apply with equal force to the formation of attitudes and behaviors toward status level (status aspirations and status attainments) and toward actual jobs (occupational preferences and occupational choices). The reasons why this model has led to some success in accounting for the formation of status aspirations while remaining barren in the explanation of actual job preferences may at first seem obscure, but upon close analysis a plausible explanation suggests itself.

In the earliest stages of the general model sketched earlier, sociostructural factors given at birth are assumed to influence the phenomenal setting of a person; that is, for example, the income level of a person's parents establishes roughly the kind of housing in which he or she will live, as well as the income level of most of the people by whom the person will be surrounded, and so on. Other persons proxemic to the individual as a result of these structural circumstances will observe the individual in the setting determined by those variables and form inferences about his or her future potential for attainment based on these observations. At the same time, of course, the person himself or herself makes similar observations and inferences. Out of this information provided by the individual's own observation and the observations and inferences of those surrounding him or her, the individual then forms conclusions about his or her own likely and desired outcomes (a "self conception"), and acts accordingly, insofar as circumstances and genetic capability permits. What is crucial in understanding the complexities of this process, however, is the recognition that no two persons will ever be in a position to observe exactly the same things about the same person: different "others" will observe the focal individual in different circumstances and different lights and probably through different attitudinal "filters" as well, and consequently no two others will form precisely the same expectations for the same person. Thus, any individual will be in receipt over time of many sets of expectations from many others, all of which differ in minor or major ways from all others and from the individual's own judgments. The question of how the individual responds to a set of *multiple* and *disparate* expectations thus becomes crucial to the attitude formation process. Investigators in the area will recognize this question of how individuals respond to disparate expectations as one of the fundamental questions of social psychology, and a problem which lies at the root of all theories of "cognitive consistency" like those of Heider (1946), Festinger (1965), Osgood and Tannenbaum (1955), Bem (1972), Anderson (1959), and others.

Investigators in the status attainment area have, consciously or unconsciously, found themselves in a specially privileged position when faced with this question. Most of the key measures of status level concepts are measures of a quantitative or quasi-quantitative nature. Educational Aspiration and Educational Attainment, for example, are quantitative variables measurable in principle and in fact on a continuous ratio scale: *number of years of education.* Occupational Aspiration and Occupation Attainment are quasi-quantitative [1] measured empirically by the highly reliable 90+ point NORC Scale of Occupational Prestige (Duncan, 1961) or the 80 point Occupational Aspiration Scale (Haller and Miller, 1962).

It was thus easily possible for investigators to *aggregate* these disparate expectations into single composite variables. For example, to deal with the question of how high school students responded to the frequently disparate expectations of parents, teachers, and examples of peer friends, Sewell, et al. (1969), utilized a *simple unweighted sum* of the three as an Index of Significant Other Influence, which was then shown to correlate highly (+0.47) with the aspirations of the individual himself (the Sewell sample was all male). This *unweighted index* was shown not significantly inferior to a best fitting linear aggregate of the same variables. Woelfel and Haller (1971) similarly utilize an average of the expectations of a more precisely established set of "significant others" fairly crudely weighted by the number of contexts through which each other had exerted influence, and report zero-order correlation coefficients in the 0.7 range between this index and measures of individual aspirations. Still other investigators have utilized indices weighted empirically by regression techniques, by factor analysis, or by other methods.[2]

What is theoretically interesting is that all these aggregation techniques universally imply some "balance-of-forces" or "equilibrium" model of the process by which individuals respond to multiple and disparate expectations. The arithmetic mean, which is the simplest frequently-used aggregate, has the following property:

$$\sum_{i=1}^{n} (x_i - X) = 0$$

that is, the mean is that point from which all deviations sum to zero. Should each incoming expectation be assumed to be of equal potential effectiveness, then such an aggregate provides the point at which all forces sum to zero, or "balance." More complex weighted averages similarly imply a balancing model, differing only in that each element in the aggregate is weighted by some factor, either theoretically or empirically derived, which represents the theoretical or empirical "forcefulness" of that element in the overall aggregate.[3]

Whichever—if any—of these procedures may ultimately turn out to be correct, aggregation of any kind has never been possible in the study of occupational choice, because none of the key choice variables have been measured quantitatively as have the principle status attainment variables. Occupational choice, as the name implies, refers to the selection of a *specific* job, and a correct prediction of an occupational choice would mean naming in advance the specific job an individual would attain in adulthood. Among those variables certain to be included in any set of predictors of adult occupational choice would be the expectations held for the individual by his or her significant others concerning his or her future job choices. In this case, unlike the case of status attainment where each expectation is defined and measured as a point on a continuum which might be treated quantitatively (i.e., added, subtracted, multiplied, averaged, and aggregated in other ways with other such measures), each expectation is defined and measured as a discrete nominal category—as, for example, the *name of a job.* These discrete variables may not be aggregated so straightforwardly, except in the simplest of cases (as when all the expectations of all the significant others are the same). In such a simple case, the prediction of the focal individual's own likely job choice seems clear. But where an individual is in receipt of many expectations from several individuals, each of whom holds an expectation different from all others, predicting the person's exact choice becomes more difficult. This situation in which an individual is faced with a set of categorically distinct and

different expectations to which he or she is presumed to respond is a difficult one.

Because the variables are only nominal, it is not possible to average or otherwise aggregate them into a single composite variable, like, for example, *average occupational expectation,* and since the individuals cannot comply with these disparate expectations, the investigator seems faced with the further significant theoretical question of how individuals choose from among the expectations held for them those to which they will respond. This question is no less difficult, however, than the original question of how individuals choose from among the occupations available to them those toward which they will aspire, and in fact may turn out to be the same question simply put back another stage. No matter how attractive may be the notion that each expectation exerts some influence, all of which contribute to an occupational choice which is minimally discrepant from all those proposed, operationally such a model has not been possible due to the nominal character of the occupational expectations and the choice itself. It should be clear from this analysis that in no small part the difficulties of occupational choice research may well be a result of the discrete nominal classification of independent and dependent variables alike, whereas the relative success of status attainment research might be very largely accountable to the highly quantified nature of its variables—both in the model and as measured empirically.

This problem is greatly amplified by several additional difficulties: first, no satisfactory *nominal* classification of occupations by type has yet been devised, and second, it is very unlikely that various diverse occupational subgroups (males, females, blacks, whites, etc.) *share* a common classification system for occupations. As a consequence, the state of affairs faced by the investigator who would study the occupational choices of special or minority groups is this: 1) no satisfactory classification system for occupation is currently available, 2) any general classification system, should one be devised, would not be likely to correspond to the classification systems used by minority and special group members, and 3) should either a general classification system or a series of special classification systems be devised, their categorical or discrete character would still constitute a substantial barrier to the analysis of the effects of multiple and disparate expectations received by an individual from his or her significant others.

With this background in mind, the present chapter has two purposes: first, the development of a theory and associated measurement procedures which make it possible to define and measure occupational choices and occupational expectations as continuous quantitative variables both in general and for special occupational groups and second, to present a plausible "balance of forces" theory describing the hypothetical process whereby formerly discrete categorical job expectations and other variables are aggregated into a single composite variable predicting actual job choice.

Theory

It is decidedly to the credit of status-attainment investigators that their central hypotheses and causal models have been drawn out of careful scrutiny of more fundamental general sociopsychological theory. This special theory of occupational choice is no exception, and begins by examining the fundamental psychological processes of human perception. Most social psychologists would agree that the process of perceiving and identifying any "object" [4] is basically a *process of differentiation* wherein the individual learns to discriminate the stimuli which are the mechanism of the perception of the object from other stimuli representing other objects on the basis of their *dissimilarities* with regard to certain underlying *attributes* (Torgerson, 1958). Thus, for example, I identify a yellow ball as different from a red ball because I recognize them to be dissimilar by a certain amount in terms of the attribute *color*. Although, in the example given, the two objects presumably differ along only two attributes, objects most frequently differ with regard to *many* attributes at once. Two persons, for example, may differ in regard to the attributes of sex, age, height, and so on through many attributes. The *aggregate* of all these dissimilarities can be taken as a measure of the *overall difference* or dissimilarity of these two persons.

Occupations, too (insofar as they constitute "objects" about which persons think), are distinguished from one another in terms of requirements, socioeconomic status, working conditions, and so on. Furthermore, it makes sense to speak of *overall* dissimilarities among occupations insofar as they differ in large or small part along more or fewer attributes. These overall dissimilarities make sense even in everyday life: such a view implies, for example, simply that a professional baseball player and a professional football player are considerably less dissimilar or "distant" from one another than either is from an accountant, banker, railroad worker, secretary, and so forth.

While usually these dissimilarities are discussed in common language (and usually by social scientists as well) in categorical terms, this need not be the case.

Dissimilarities among objects may be represented by a continuous numbering system such that two objects considered to be completely

identical are assigned a paired dissimilarity score or distance score of [0], and objects of increasing dissimilarity are represented by numbers of increasing value. Assuming that the definition of an object or concept is constituted by the pattern of its relationship to other objects, the definition of any object may be represented by a $1Xn$ vector where d_{11} represents the distance or dissimilarity of object 1 from itself.

$$d_{11}, d_{12}, d_{13}, \ldots, d_{1n}$$

(thus $d_{11} = 0$ by definition), d_{12} represents the distance or dissimilarity between objects 1 and 2, and d_{1n} represents the distance between the 1*st* and the *n*th objects. Similarly, the second object may be represented by a second vector

$$d_{21}, d_{22}, d_{23}, \ldots, d_{2n}$$

and the definition of any set of concepts or objects may therefore be represented in terms of the matrix

$$\begin{matrix} d_{11}, d_{12}, \ldots, d_{1n} \\ d_{21}, d_{22}, \ldots, d_{2n} \\ d_{n1}, d_{n2}, \ldots, d_{nn} \end{matrix}$$

where any entry d_{ij} represents the dissimilarity or distance between i and j.

Clearly the matrix D has the abstract capacity to describe all the possible interrelationships among any number of objects, and just as clearly, there is room for infinite variety. First of all, D can represent anything that can be said in categorical terms with no error of translation as the accompanying career matrix makes clear.

	Doctor	*Plumber*	*High Paid*	*High Status*	*Romantic Work*	*Self-Employed*	*Indoor Work*
Doctor	1	0	1	1	1	1	1
Plumber	0	1	1	0	0	1	1

The first row of the matrix shows that the job "Doctor" has the properties doctor (by definition), high-paid, high-status, romantic work, self-employed, and indoor work. The second row shows that plumber has the quality plumber (again, by definition), high-paid, self-employed, and indoor work. Since it uses only a categorical logic of classification, however, the entries in the matrix are restricted to zeros (absence of a quality) and ones (presence of a quality). Obviously, such a restriction eliminates a great deal of information about both doctors and plumbers that is available even in terms of just these qualities.

While both doctors and plumbers are seen to be "high-paid" in this example, the categorical logic does not allow any difference in salary to be expressed.

If the entries in the matrix were allowed to take on any positive real value, however, and the number of objects on which doctor and plumber were compared were to be increased without limit, then clearly the range of subtlety and complexity—the nuances of meaning—that could be conveyed in this matrix would be adequate to far beyond the range of complexity of human perception. The richness of description made possible by this model is made clearer still when it is understood that D represents the static structure of the interrelationships among the set of N objects—in this case occupations—at any instant in time, and that, as time passes, the processual character of these relationships can be captured in successive matrices, $D_{t0}, D_{t1}, \ldots, D_{tn}$, where the intervals between time periods, 0, 1, 2, . . . , n, can be made as small as desired.

The theory presented so far has as its most primitive concept the notion of distance or dissimilarity, and the problem of measuring the variables in the theory therefore, reduces to the problems of measuring distances. It is a fundamental belief of this theory that the measurement of these psychological or cultural distances is more closely analogous to the measurement of physical distances than is usually supposed. In fact, as Einstein argues (Einstein, 1961),

> For this purpose [the measurement of distance] we require a "distance" (Rod S) which is to be used once and for all, and which we employ as a standard measure. If, now, A and B are two points on a rigid body, we can construct the line joining them according to the rules of geometry; then, starting from A, we can mark off the distance S time after time until we reach B. The number of these operations required is the numerical measure of the distance A B. This is the basis of all measurement of length.

Similarly, the measurement of the distance among objects of cognition can be accomplished simply by arbitrarily designating the distance between any two cognitive objects as a standard and comparing the distances (i.e., dissimilarities) between any other pair of objects to this standard.[5]

It is not a distance between cognitive objects in some abstract sense which is to be measured, of course, but perceived distance—i.e., the judgments of distances made by individuals and cultures. Consequently, what is needed are judgments of dissimilarities among objects made by respondents but expressed as ratios to some standard unit provided by the experimenter. This can be accomplished quite directly by a question worded in the form:

"If x and y are u units apart, how far apart are a and b?"

Such wording requests a dissimilarities judgment from a respondent (". . . how far apart are a and b?"), but requests that this judgment be made as a proportion of a standard distance provided by the experimenter ("If x and y are u units apart, . . .").

This technique has several key advantages. First and foremost, no restrictions are placed upon the respondent, who may report any positive real value whatever for any pair. Thus the scale is unbounded at the high end and continuous across its entire range. Secondly, because the unit of measure is always the same (i.e., the unit is provided by the investigator in the conditional, "If x and y are u units apart," and thus every scale unit is $\frac{1}{u}$ units) and because the condition of zero distance represents identity between concepts and is hence a true zero, not at all arbitrary, this scale is what social scientists usually call a *ratio scale,* which allows the full range of standard arithmetic operations. Third, since the unit of measure is provided by the experimenter, it is possible to maintain the same unit of measure from one measurement to another, both across samples and across time periods, which is crucially important since time is one of the primitive variables of scientific theory. These three characteristics taken together provide the capacity for comparative and time-series analyses at very high levels of precision.

While the technique suggested meets the criterion for scaling quite exactly, and in fact will be the technique of choice in the measurement of aggregate cultural patterns, problems of unreliability make it unsuitable for the measurement of individual self-conceptions. It is axiomatic in psychometrics that the reliability of any scale is inversely proportional to the complexity of the judgmental task required of the respondent. The technique of direct-paired distance estimates requires a highly complex set of judgments from the respondent and is consequently too unreliable for very precise measurement of individual psychological contents (typical test-retest reliability correlations range in the .70s).

What error does occur in the measurement of individual self-conception, however, has the overwhelming advantage of being random error, as is all unreliability (as opposed to invalidity) of measure. Such random errors will be distributed normally in any series of measures. Should any number of persons n respond to a paired-comparison question like the one just specified, the theorems of central tendency and large numbers assure that the scores obtained will be normally distributed about a sample mean score, and that that sample mean will converge on the population true score as n becomes large.

This resulting matrix [6] **D,** given appropriate sampling, will represent the structure of the occupational system as it is perceived in the aggregate by the members of the culture from which the sample was drawn. Unlike unidimensional models (like the NORC scale) all culturally shared aspects of the occupational structure will be represented in the matrix **D** insofar as they influence the aggregate definitions of occupations.

An important characteristic of the matrix **D** is the fact that it will represent the occupational structure as it is perceived in the aggregate by the members of the population from which the sample is drawn. Moreover, since the direct-paired comparison estimates by which data are taken do not require that the attributes along which comparisons are to be made be specified in advance, this technique is particularly well suited to the investigation of special and minority groups whose conception of the occupational structure may not correspond closely to that of the major culture. As suggested earlier, a major problem of occupational choice research has been the fact that a satisfactory classification system for occupations is not available in general, and even if such a scheme were to be devised, there is good reason to suggest that it would not reflect definitions of occupations as held by multiple and disparate special and minority groups. These procedures overcome this problem by providing techniques whereby a classification of occupations can be obtained directly from the sample under investigation in the context of the data collection, thus obviating the need for any prior classification scheme. Thus, for example, if sampling were restricted to American Indians, the results of these procedures would be a mean matrix **D** which described the occupational structure *as perceived by American Indians.* Occupational choices made from this structure would be based on definitions of these jobs and their interrelationships held by the sample members and not from a set of occupations whose definitions, meanings and interrelationships are provided by the researcher.

Analysis

Once this work has been accomplished, the result is an aggregate definition of a set of occupations in the form of a matrix of continuous dissimilarities scores whose reliability can be brought to any desired level by manipulation of the sample size. This matrix has a great many advantages. First, it provides a meaningful classification of occupations based on their dissimilarities as perceived by the aggregate culture, and provides these as continuous, quantitative, and unbounded scales of any desired reliability. Secondly, following from the quality of these scales, advanced mathematical operations like multiplication, division, averaging, etc., are permissible, and balance-of-forces aggregates like those used by status-attainment workers may be attempted.

The utility of this conceptual system can be made even more graphic when we recall that any matrix describes an implicit vector space V_k where k (the dimensionality of the space) $\leq N - 1$, where N is the order of the original matrix.

Although any matrix describes its underlying vector space fully, as the order of the matrix becomes large, calculations based on these matrices can become quite cumbersome; and the visualization of such spaces becomes impossible as the dimensionality (k) exceeds three. Given the condition $k \leq n - 1$, however, such operations are seldom necessary.

Obtaining the underlying vector space from the matrix **D** is straightforward.[7] Procedurally, the data collection outlined earlier yields a three-dimensional, concepts × concepts × person matrix which is averaged across the n persons into a two-dimensional, concepts × concepts square symmetric matrix **D,** where any entry $\mathbf{d}_{ij}$ represents the average distance between concepts i and j as seen by the respondents. This matrix **D** is transformed routinely into a scalar products matrix B * (Young and Householder, 1938), although it is generally the practice of investigators to "double-center" this matrix by establishing an origin for the space at the centroid of the distribution. This can be done simply during the construction of the scalar products matrix, and the transformation for any cell b^*_{ij} is given by the equation

$$b^*_{ij} = 1/2 \left(\frac{\sum_{i=1}^{n} d^2_{ij}}{n} + \frac{\sum_{j=1}^{n} d^2_{ij}}{n} - \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} d^2_{ij}}{n^2} - d^2_{ij} \right)$$

which is a straightforward linear transformation that sacrifices none of the information present in the original matrix **D** (Torgerson, 1958).

This new centroid scalar products matrix is such that any entry:

$$b^*_{ij} = p_i p_j \cos \alpha_{ij} \quad \text{where} \quad \begin{aligned} p_i &= \text{the length of vector } i \\ p_j &= \text{length of vector } j \\ \alpha_{ij} &= \text{the angle between } i \text{ and } j \end{aligned}$$

Consequently, when this matrix B^* is reduced to a base by routine factorization (i.e., the application of any standard routine, such as principal axis or jacobi), the result is a factor matrix, **F**, whose columns,

$F_1, F_2, \ldots, F_k$, are orthogonal vectors with their origin at the centroid of the vector space spanned by **F** and where any entry f_{ij} represents the projection (loading) of the *i*th variable on the *j*th factor. This matrix has further properties such that:

$$p_i = \sqrt{\sum_{j=1}^{k} d_{ij}^2}$$

That is, the square root of the sum of squared projections of the *i*th variable across all the *k* factors equals the length of the vector of the *i*th variable, and of central concern:

$$\mathbf{d}_{ij} = \sqrt{\sum_{f=1}^{k} (d_{if} - d_{if})^2}$$

This last expression shows that the original distance matrix can be completely recovered from the factor matrix with no loss of information.

V_k is a spatial coordinate system defined by the distance relations among the cognitive objects which are its contents. It has the property that objects defined as similar by any individual or culture will be located close to each other in the space, or more precisely that the distance between any pair of objects in the space is directly proportional to their perceived dissimilarity. The precise definition of an object, therefore, is given by its location in V_k; and, as a corollary, any change of definition of any object is represented by its movement through the space over time.

Within this space, any occupation is defined (i.e., located in the coordinate system V_k) as a vector whose beginning is on the origin, and whose end point is given by its coordinates on the *k* dimension of the space. Each expectation is similarly defined as a vector from the origin to a point whose location is given by its coordinates on the *k* dimension.

Figure 1 is an arbitrary description of the occupational space V_k where $k = 2$—i.e., it is drawn in two dimensions for simplicity—but larger values of *k* present no mathematical difficulty, even though visualization is no longer possible for $k > 3$. The two axes of the space are arbitrarily named *x* and *y*, and although "naming" or identifying these factors in terms of some underlying dimension like SES may be instructive, it is not necessary.

Within this space, the interpoint distances among all the occupations listed as (hypothetically) estimated by a sample of respondents are faith-

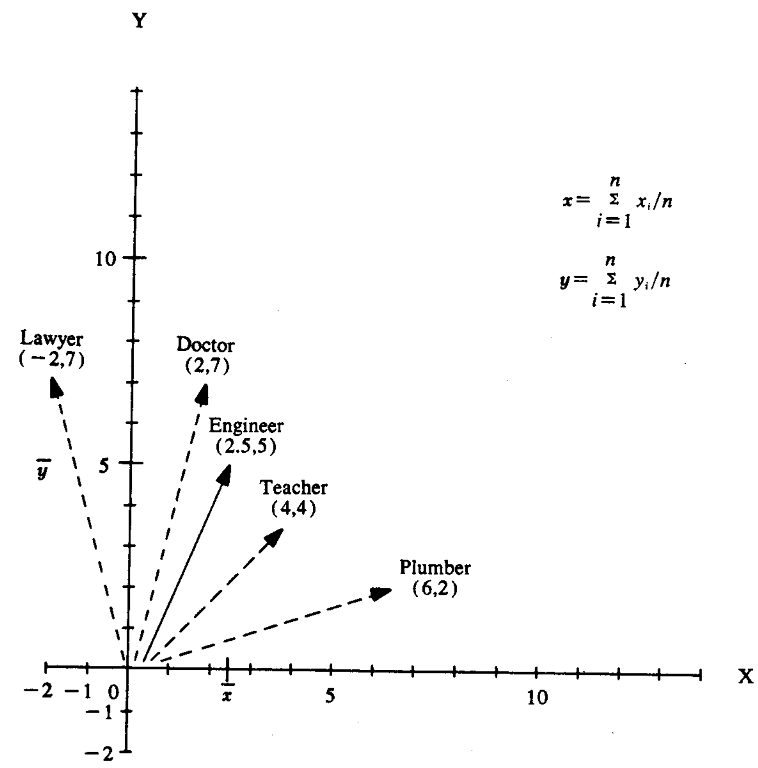


FIGURE 1

fully reproduced. Each occupation's location in the space is given by two numbers—its *x* and *y* coordinates. (In a V_3 of course, three numbers would be required, and in general for V_k, *k* numbers are needed.) Thus the coordinate pair (2,7) locates "plumber," etc. For illustrative purposes, it is assumed that Figure 1 represents the expectations four "significant others" hold for an individual. These four expectations are plumber (6,2), teacher (4,4), doctor (2,7), and lawyer (−2,7). These expectations are represented by dashed vectors from the origin to the occupations expected by each other. (Although the space contains other occupations as well, these are left out for clarity.) Figure 1 exhibits reasonably wide variance in these expectations, and a balance-of-forces model suggests choosing an occupation somewhere in the "middle" of this spread. On the simplest level, such an index might well be provided by the *multidimensional average,* which is obtained by averaging all coordinate scores on each dimension into an average coordinate score for that axis. Thus the x coordinate score for the multidimensional average is given by $\mathbf{x} = \sum_{i=1}^{n} x_i/n$, and the y coordinate score is given by $\mathbf{y} = \sum_{i=1}^{n} y_i/n$. These operations yield average **x** and **y** coordinates for the data in Figure 1 of (2.5,5) and this *average expectation* is represented in Figure 1 by the solid vector from the origin to the point (2.5,5). The closest occupation to this point (in this example) is *engineer,* and this is the occupation—other factors equal—to which the individual might be expected to aspire, or more precisely, the occupation whose choice would most nearly balance the disparate forces of the expectations. While visual examination of Figure 1 shows the vector (2.5,5) to be reasonably centrally located, analytically this can be shown to result from the fact that all deviations from this point will sum to zero, as is the case for the unidimensional mean. Furthermore, it can be shown that the vector (2.5,5) is a least-squares point—i.e., the sum of squared deviations from itself are at a minimum.

Of course, this simple balance model may be too simple, since it assumes each expectation held by each other to be equally effective or forceful. Differential forcefulness of different sources or expectations, at least in the simplest case, can be had easily by providing some multiplicative constant μ_i, for each source, so that

$$\mathbf{y} = \sum_{i=1}^{n} \mu_i y_i/n$$

$$\mathbf{x} = \sum_{i=1}^{n} \mu_i x_i/n$$

This model retains its balance properties, while providing perhaps more plausible estimates of the forces of each expectation or each source or "significant other." How such weights might be estimated is not entirely clear. Although theoretical bases for such weights abound, extensive empirical research has revealed no consistent strong effects of such variables as affect, credibility, primacy-recency, and others on the effectiveness of persuasive messages. Research on the effects of propinquity on intercommunication patterns and interpersonal influence suggests that *frequency of communication* might be investigated as a basis for such weights.

Furthermore, the model represented in Figure 1 accounts only for influences resulting from the actual job expectation of significant others. A more reasonable model would account as well for influences exerted

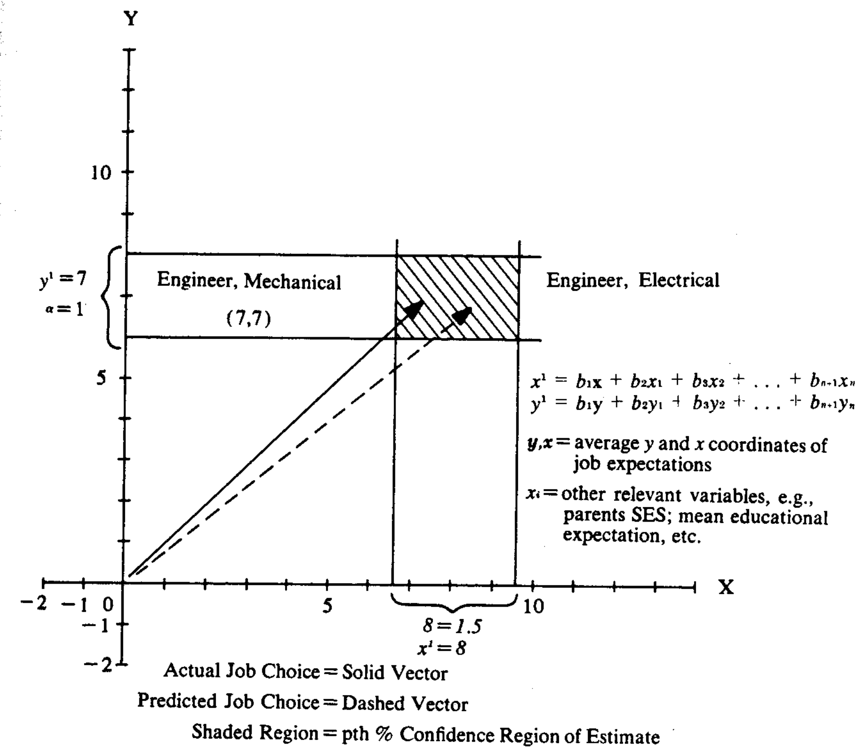


FIGURE 2

by significant others by means other than specific job expectations—as, for example, by means of their *educational* expectations—and further include influences from environmental influences other than significant others (like media, economic factors, etc.).

Figure 2 presents a model expanded to account for these other variables. As Figure 2 makes explicit, the measured job choice (i.e., the individual's current job preference as reported by the individual) may also be represented in the occupational space V_2. Like any other occupation, its location is given (in V_2) by its coordinate values on each of the two axes, in this case (7,7). Since the location of the actual job choice is wholly given by its coordinate values, prediction of the job choice can be accomplished by prediction of each of the values. Thus, for example, the x coordinate value might be predicted by a regression equation whose independent variables include among them the mean (or weighted mean) **x** coordinate value of the job expectations which the person has received. Other relevant variables might include those already shown effective in status attainment research, like levels of educational and occupational expectations of significant others, socioeconomic status, and measured mental ability, among others, and perhaps including the individual's own status aspirations. This equation might take a form such as

$$x' = b_1X + b_2X_1 + b_3x_2 + \ldots + b_{n+1}X_n$$

and similarly, for the y coordinate value

$$y' = b_1Y + b_2X_1 + b_3X_2 + \ldots + b_{n+1}X_n$$

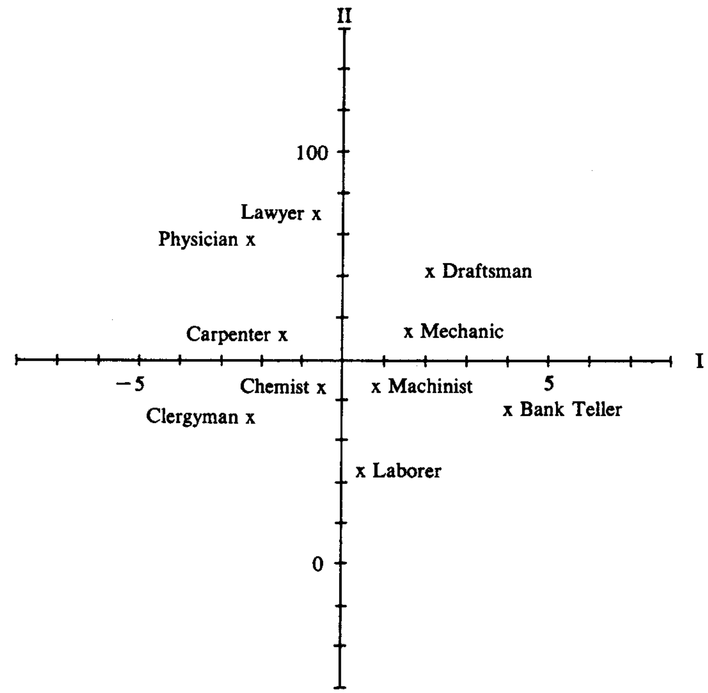
where x' = the predicted x coordinate of the individual's job choice
y' = the predicted y coordinate of the individual's job choice
b_i = empirically derived regression coefficients
$\overline{X}$ = the mean of the x coordinates of the job expectations of the individual's significant others (or the weighted mean)
$\overline{Y}$ = the mean of the y coordinates of the job expectations of the individual's significant others (or the weighted mean)
x_i = other relevant variables, like significant others' status expectations, SES, etc.

TABLE 1*

ESTIMATED COORDINATE VALUES FOR CHOCTAW INDIANS AND A GENERAL AMERICAN POPULATION FOR TEN OCCUPATIONS (TWO-DIMENSIONAL SECTION)

Occupation	*Dimension I*	*Dimension II*	
	From Burton (1972)	*Choctaw*	*Duncan SEI*
Physician	−2.0	79	92
Lawyer	− .8	81	93
Draftsman	1.9	72	67
Carpenter	−1.4	50	19
Machinist	.7	47	33
Bank teller	4.0	38	52
Laborer	.2	25	7
Clergyman	−2.2	36	52
Chemist (natural science)	− .5	45	80
Mechanic	1.2	55	19

* Scores on Dimension I are estimated for a sample of Harvard undergraduates following Burton (1972). Scores on Dimension II represent occupational prestige estimates for a sample of Choctaw Indians (see Spencer, et al., this volume) and for a general American population from the Duncan SEI.



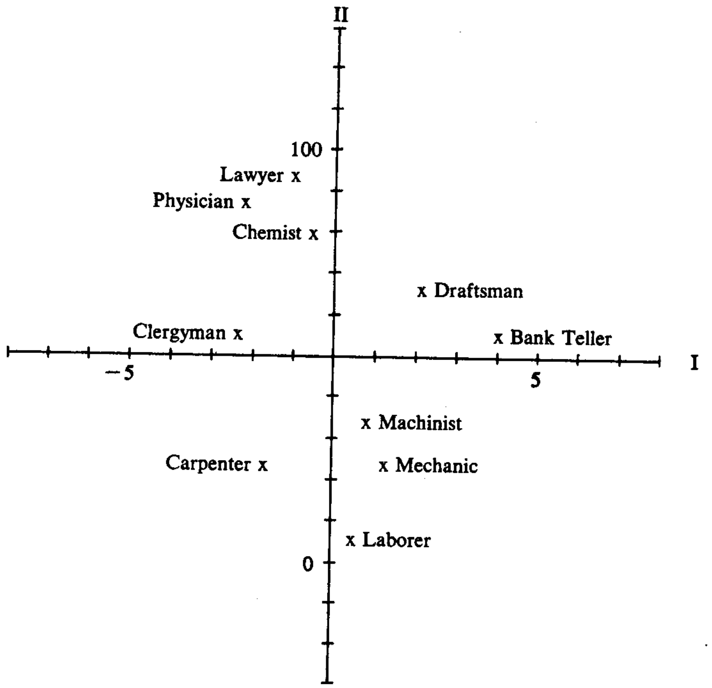
* Loadings on the first dimension are estimated from the non-metric *MDSCAL* plot from Burton (1962). Dimension two is estimated by data provided by Spencer, et al., (this volume).

FIGURE 3

TWO-DIMENSIONAL CONFIGURATION OF CONCEPTIONS OF TEN OCCUPATIONS AS PERCEIVED BY CHOCTAW INDIANS *

One such equation is required for each dimension of the occupational space; thus k equations are required for a V_k. Each of these equations will yield a predicted coordinate value around which confidence intervals may be set (as shown in Figure 2 by the intervals surrounding the predicted coordinate values) just as one might do with any ordinary multiple regression equation, which in fact these equations are. The intersection of these confidence bands yields a k-dimensional confidence region whose size is a function of the percent of confidence required and the standard errors of estimate of the k multiple regression coefficients. The correct job choice can be said to be within this region within the level of confidence chosen.

Still more complicated models might anticipate reciprocal influence among the variables within each equation and even between the coor-



* Loadings on the first dimension are estimated from the non-metric *MDSCAL* plot from Burton (1962). Dimension two is estimated by the Duncan Socio-Economic Index—see Spencer, et al., (this volume).

FIGURE 4

TWO-DIMENSIONAL CONFIGURATION OF CONCEPTIONS OF TEN OCCUPATIONS AS PERCEIVED BY A GENERAL AMERICAN POPULATION *

dinate values and the independnt variables,[8] so that the simultaneous equation systems like non-recursive path analytic models might be used to predict each coordinate value.

As suggested earlier, different populations and subcultures should be expected to perceive the structure of the occupational hierarchy differently. Figure 3 represents an estimated plotting of the configuration of ten occupations represented in two dimensions as perceived by Choctaw Indians (Table 1, p. 56), while Figure 4 represents an equivalent plot for a general American population. While these configurations have been estimated from data taken from several sources and thus represent only crude approximations of the true configurations, nevertheless they show clearly the extent to which the configuration representing the aggregate conceptual domains of two distinct subcul-

tures may differ. Clearly, attempts to predict job choices of Indians within the conceptual domain of a general American population would be doomed to failure. These procedures, however, make it possible to plot the occupational choices of any subcultural group within a multi-dimensional scale of the occupational domain derived from that same sample.

While this model, therefore, is a conceptually simple-minded balance model, it is in no way simple in terms of the *empirical complexity* it may reflect and account for. It has as its main advantage its ability to treat discrete choices in a quantitatively exact way, so that the more powerful mathematical procedures and theoretical hypotheses developed in more advanced areas may be applied to their description and explanation. In practice, of course, this would most likely constitute the theoretical structure and mathematical procedures of status attainment theory and research.

NOTES

1. I.e., scales which are clearly more than ordinal in that they give *estimates of distances* between individuals scaled as well as rank ordering, yet are less than quantitative in that the equality of their intervals (and consequently *precision* of distance estimates) can not be guaranteed.

2. The implications of some of these aggregation procedures have been explored in some detail elsewhere. See particularly Woelfel and Hernandez (1973), Saltiel and Woelfel (1973), Webster, et al., (1972), and Anderson (1959).

3. That weighted averages still exhibit balance properties can be shown easily. For a weighted mean,

$$X = \frac{\sum_{i=1}^{n} u_i x_i}{n}$$

and x has the property

$$\sum_{i=1}^{n} (u_i x_i - X) = 0$$

4. By "object" is meant anything that can be designated or referred to, not merely physical objects like chairs and desks, but psychological objects as well, like beliefs and ideas.

5. While there is truly a great range of freedom from within which the comparative standard may be chosen, certain criteria for making such a choice may be specified. First, the standard should be relatively stable. Changes in the standard over time can confound time series measurements and prevent meaningful comparisons of measurements made at different times. Secondly, the standard should be the same for all observers regardless of reference point—i.e., two independent observers must both agree on the length, for example, of a meter of a kilometer. Less

important, but nonetheless worthy of consideration, good practice for minimum error suggests using a standard approximately midway between the largest and smallest measurement likely to be encountered (measurement of astronomical distances in miles, for example, is cumbersome, as would be measurement of terrestrial distances in fractions of light-years). These criteria, however, are never achieved in any science. No distance, for example, is truly invariant; no clock emits signals so that ". . . the duration between any two signals is (*exactly*) the same. . . ." Secondly, at least within the framework of relativistic physics, viewers in referent systems moving at differential velocities with regard to one another will not agree on distances or durations of time when viewing the same events. Whatever consequences failures to meet these criteria *exactly* may be for philosophy, they are not insuperable barriers to science.

6. More precisely, any cell $\mathbf{d}_{ij}$ of the matrix D is given by

$$\mathbf{d}_{ij} = \sum_{k=1}^{n} \frac{d_{ijk}}{n}$$

where i = occupation i
j = occupation j
k = person k

7. The technique outlined in the following pages is based on the classical multi-dimensional scaling model well-known to psychometricians. Other non-metric scaling models are available, but these techniques apply principally to the reduction of matrices which are merely ordinal, and so are not applicable to the continuous, reliable, ratio scaled data provided by the measurement system proposed in this article. See particularly Shephard (1966).

8. Reciprocal influence *among the coordinate values themselves* is not possible since they are orthogonal by design and in fact when obtained by the procedures outlined in this chapter.

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