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PHILOSOPHICAL IMPLICATIONS OF A SYSTEM OF SOCIAL ACCOUNTS BASED ON ROGER BARKER'S ECOLOGICAL PSYCHOLOGY AND A SCALAR MEASURE OF TOTAL INCOME

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Social indicators and measures of the quality of life will remain difficult to interpret unless they are embedded in a system of social accounts that is comprehensive in scope; such a system will be premature unless it is supported by a theory which leads to reproducible classifications and methods of observation and measurement of all types of human behavior. This implies an integration of theory, methods, and data across portions of several social sciences.

I believe such an integration can be effected by extending and adapting the young discipline of *ecological psychology*, pioneered since 1947 by Roger Barker, so that its relations to economics, sociology, and the rest of psychology are made clear and operational. Although Barker has received the highest honors from the American Psychological Association (Distinguished Scientific Contribution Award, 1963, and G. Stanley Hall Award, 1977) and from the Society for the Psychological Study of Social Issues (Kurt Lewin Memorial Award, 1963), his work is still not widely known among sociologists, economists, and philosophers. In my current approach to comprehensive social accounting, I have tried to link Barker's system with several others each of which has been developed for a different purpose by a different group of specialists.

The editor of this issue invited me to contribute to it on the basis of my 1974 book, *Social Indicators and Social Theory*, and also to comment on the empiricist bias of much work in this field. I shall do these things at the outset and then describe some developments I hope to publish soon in a four-volume manuscript (Fox, ed., 1980).

1. Derivation and Implications of a Scalar Measure of Total Income for Individuals and Population Aggregates

This article would have been much shorter if I had written it during 1969—1974 when I was dealing only with concepts and not with data. In Fox (1969) I combined Barker's concept of behavior settings, which I first heard of in October 1966, with Talcott Parsons' concept of generalized media of social interchange, which I encountered in Parsons (1968) shortly after it appeared. Later, Paul Van Moeseke confirmed most of my conjectures, reformulated my model, and established my original results plus important new ones in Fox and Van Moeseke (1973), which was reprinted almost verbatim as Chapter 3 of Fox (1974); some excerpts follow, with page numbers as in Fox (1974).

"We introduce a scalar measure of an individual's social income (SI) which includes returns in terms of social media of exchange other than money, such as professional standing and political power, in addition to money income from property and transfer payments.

We show that such a scalar measure exists if the individual is assumed to optimize the allocation of his time among alternative behavior settings under a number of social constraints. SI is computed with the help of a mathematical programming model: since one of the constraints is financial, the dual variables pertaining to the remaining constraints, and hence SI, can be equally well expressed in dollars.

A number of desirable, and empirically meaningful, properties are derived by mathematical programming techniques. Some implications of our approach for policy models, output measurement, demand analysis, and the study of income distributions are suggested in the concluding sections (p. 29)

Outline of the Mathematical Derivation and Implications

From a sociological viewpoint, the individual is active in a number of behavior settings belonging to the economy, the polity, the church, the family, the club, and so on. Within each behavior setting, his activity is guided — and restricted — by inputs and outputs (or contributions and rewards) in terms of a number of media of exchange such as money, influence, votes, and professional standing.

We assume in Section 3.3 that the individual optimizes the allocation of his time among alternative behavior settings under a number of constraints pertaining to several media — money included. The resulting programming model theoretically allows the derivation of a scalar measure, called social income (*SI*) and expressed in dollars, of the individual's rewards in terms of all social media of exchange, and resulting from his activities in all relevant behavior settings. Summation over individuals would then yield a figure, expressed in dollars, for the social income of any specified population aggregate (nation, region, state, age, sex, occupation, or other grouping).

In Section 3.4 empirically meaningful implications of the programming model are derived, in particular: the individual's utility need only be defined up to a monotonic transformation; *SI* changes proportionately with the general price level in the economy; the individual's choice is invariant under proportional changes (in particular, changes in the unit of measurement) of inputs and outputs of any medium of exchange; his choice further satisfies the elasticity rule and the Le Chatelier principle. In Section 3.5 a quadratic approximation to the individual's utility function is derived. (p. 32)

The Model

The individual divides one period of time (the current accounting period) over n behavior settings, hereafter interchangeably referred to as *settings* or *activities*, spending the fraction x_j of the unit period on the jth activity. The n tuple $x_j, j = 1,2, \ldots, n$, is denoted by x (where $x \in R^n+$). Formally, an *individual* is a triple ($u\colon \mathrm{R}^n + \rightarrow R$; A; b), where u is his utility function; A and b are real matrices, respectively, $m \times n$ and $m \times 1$; b denotes the endowment (or resources) in terms of the different media of exchange; and the elements a_{ij} of A are input coefficients: a unit of the jth activity absorbs a_{ij} units of b_i. The matrices x, A, b express the individual's *life style*, *environment*, and *endowment*, respectively[1].

He faces the programming model (P),

$$\text{maximize } u(x), \quad \textit{subject to} \tag{1}$$

$$Ax \leqslant b, \tag{2}$$

$$x \geqslant 0. \tag{3}$$

The set $X \equiv [x \geqslant 0 \mid Ax \leqslant b]$ is called the *feasible set* of possible activity levels (time allocations to alternative settings).

By way of illustration, we write out the first three rows of (2):

$$-p_1x_1 + p_2x_2 + \cdots + p_nx_n \leqslant y, \tag{4}$$

$$x_1 + x_2 + \cdots + x_n \leqslant 1, \tag{5}$$

$$-w_1x_1 - w_2x_2 - \cdots - w_nx_n \leqslant -w, \tag{6}$$

and we assume that x_1 denotes time spent at work, x_2, time spent shopping at the grocery store, and so on. Income constraint (4) is the reduced form of $p_2x_2 + \cdots + p_nx_n \leqslant y + p_1x_1$, stating that expenses incurred in activities 2 through n cannot exceed money income (from property and transfer payments y, and current personal services p_1x_1, where p_1 denotes the wage rate). The meaning of time constraint (5) is obvious. Constraint (6) is the reduced form of $w_1x_1 + w_2x_2 + \cdots + w_nx_n \geqslant w$: in the case of, say, a local politician, election requires at least w votes; activity 1 is estimated to yield w_1 votes per unit of time spent at work (law practice or union activity, say), w_2 per unit of time spent at the grocery store, and so on. Put another way, the left side of (6) is a linear approximation to the assumed functional relationship $w = w(x_1, \ldots, x_n)$ between votes obtained and time invested in alternative behavior settings. Such linearization is neither more nor less rebarbative in a social than in an economic context, where linear activity analysis (Koopmans, 1951) in general, and input-output tables (Leontief, 1951) in particular, are standard tools in approximating production functions.

Analogously, in the case of a research worker, w may express an output requirement (e.g., pages or papers published), and the w_j may denote estimated average yields from time spent in such behavior settings as work, professional contacts, and relaxation.

As illustrated by (1) to (6), the a_{ij} may denote inputs or outputs according as $a_{ij} > 0$ or < 0. Furthermore, the b_i denote endowments or requirements according to whether $b_i > 0$ or < 0. (pp. 32—33).

Mathematical Properties of the Model

We make the standard assumption that u is concave (i.e., has the usual properties of risk aversion and nonincreasing returns). By the saddlepoint theorem (Uzawa, 1958), x^* solves (P) — assuming the Slater regularity condition : $Ax^o < b$ for some $x^o \geqslant 0$ — if and only if there is a real n tuple $v^* \geqslant 0$ such that (x^*, v^*) is a *saddlepoint* of the Lagrangian $L(x,v) \equiv u(x) + v(b - Ax)$; that is, if and only if

$$u(x) + v^*(b - Ax) \leqslant u(x^*) + v^*(b - Ax^*) \leqslant u(x^*) + v(b - Ax^*)$$

$$\text{for all } x \geqslant 0,\ v \geqslant 0. \tag{7}$$

Clearly, the second inequality holds if and only if

$$v^*(b - Ax^*) = 0. \tag{8}$$

The coordinates x_j, v_i of x, v are called primal and dual variables, respectively.

The standard interpretation of v^* as a price system for endowments b_i (in terms of maximand u) is well known. Consequently, the solution of (P) implies the valuation of total endowment at

$$v^*b \equiv \Sigma v_i{}^*b_i = v_1{}^*y + \cdots + v_m{}^*b_m. \tag{9}$$

We define

$$SI \equiv \frac{v^*b}{v_1{}^*} = \Sigma \frac{v_i{}^*}{v_1{}^*} b_i = \frac{v_1{}^*}{v_1{}^*} y$$

$$+ \frac{v_2{}^*}{v_1{}^*} b_2 + \cdots + \frac{v_m{}^*}{v_1{}^*} b_m, \quad (v_1{}^* > 0), \tag{10}$$

which evidently has the same dimension as y, namely, dollars. *Total income*, including income from current personal services, is then $p_1x_1{}^* + SI$. If u is known, the value of SI is given by (10) : we indicate in Section 3.5 how a quadratic approximation to u can be estimated." (p. 33—34).

"Putting $r^* \equiv v^*A$, one has $r^*x^* = v^*Ax^* = \Sigma\, r_j{}^*x_j{}^* = \Sigma_j(\Sigma_i v_i{}^*a_{ij})\, x_j{}^*$. Also, by (8), $r^*x^* = v^*b$. Hence $r_j{}^*$ can be interpreted as the *cost* $\Sigma_i\, v_i{}^*a_{ij}$ of resources used up per unit of activity level j. Total cost r^*x^* equals total resource value v^*b. One would expect activity level j to be reduced if its cost $r_j{}^*$ increases. (p. 38).

Implications for Policy Models, Output Measurement, and Demand Analysis

A fully developed system of social accounts should enable us to address problems of growth, stability, and equity in terms of total income $(SI + p_1x_1)$ and each of its major components, p_1x_1, y, and $(SI - y)$. Models of national economics would then be perceived as components of models of the social system as a whole. Tinbergen's (1952) "theory of economic policy" might be extended to include in quantitative models noneconomic as well as economic targets and instruments of national policy. At the least, attempts to estimate, in nonmoney as well as money terms, the costs to individuals associated with different combinations of inflation and unemployment might lead to revisions in the relative weights assigned to these targets in the objective functions of policy models. The same might be said of target and instrument variables generally. Similarly, the general Efficiency Criterion (Van Moeseke, 1968) may be redefined relatively to a decision space including noneconomic dimensions.

The allocation of an individual's resources among behavior settings also has considerable interest. Recall that utility u in our mathematical model depends only on x, the "life style" vector of proportions of the individual's time spent in the various behavior settings. In equilibrium, he pays "total prices" of r_j^*/v_1^* and r_k^*/v_1^* per unit of time spent in the jth and kth settings, respectively; these prices must stand in the same ratios as their marginal utilities :

$$\frac{r_j^*/v_1^*}{r_k^*/v_1^*} = \frac{\delta u}{\delta x_j^*} \Big/ \frac{\delta u}{\delta x_k^*} \,. \tag{21}$$

Indeed, by the fourth (KT) condition $x_j^*, x_k^* > 0$ implies equalities for the corresponding indices j, k in the third condition :

$$u_{xj}^* = \sum_i a_{ij} v_i^*; \quad u_{xk}^* = \sum_i a_{ik} v_i^*. \tag{32}$$

Since $r^* = v^*A$, one has further, by the implicit-function rule :

$$-\frac{\delta x_k}{\delta x_j} = \frac{u_{xj}^*}{u_{xk}^*} = \frac{\Sigma_i a_{ij} v_i^*}{\sum_i a_{ik} v_i^*} = \frac{r_j^*}{r_k^*} \,. \tag{33}$$

Note, further, that $r_j^*x_j^*/v_1^*$ can be regarded as an output or reward produced in setting j and valued at resource cost. In extended notation, $r_j^* = \Sigma_i v_i^* a_{ij}$, and in dividing both sides of the equation by the marginal utility of money v_1^*, the cost of each resource is converted into dollars.

Our model requires that $r^*x^*/v_1^* = (v^*b)/v_1^*$. If we expand the endowment vector to include skill and health, thus including income from personal services $p_1x_1^*$ in $(v^*b)/v_1^*$, the equality states that the individual's total income $(SI + p_1x_1^*)$ equals his total expenditures r^*x^*/v_1^*. The relation

$$(r_1^*x_1^* + r_2^*x_2^* + \ldots + r_n^*x_n^*)/v_1^* = SI + p_1x_1^* \qquad (34)$$

is formally analogous to the money income constraint in the theory of consumer choice. The dollar unit of measure applies to all individuals, and the equality holds when total income is aggregated over individuals.

Hence the demand for life styles (i.e., for occupancy of, and participation in, behavior settings) should be amenable to quantitative representation. The elasticity rules derived in Section 3.4 can be regarded as generalizations of corresponding rules in demand theory, and Frisch (1959) has shown that those rules have important consequences for models of national economies. In principle, time series observations on (1) the proportions of time allocated to specified categories of behavior settings, (2) the total costs per hour of occupying them, and (3) total income per capita, should permit us to estimate statistical demand functions for participation in each kind of behavior setting. In practice, an initial rough approximation to such functions might be based on a priori information. If n categories of behavior settings were used to classify total hours of living time per person per year. Frisch's approach would yield an $n \times (n + 1)$ matrix of elasticity coefficients with respect to the n measures of total price per hour and to total income per capita. Although some pairs of behavior settings might be complementary, competitive relationships would predominate. The $n + 1$ coefficients in each row would sum to zero. The n coefficients with respect to total income would have a weighted average of 1 and the $n \times n$ coefficients with respect to total prices per hour would have a weighted average of -1; the weight applied to all coefficients in the ith row would be the proportion of total income that was expended on the ith category of behavior settings. An equal percentage increase in all total prices and in total income per capita would leave the allocation of time among behavior settings unchanged.

The present model applies to a single accounting period. It could be extended to deal with generalized human capital transactions and the evaluation of policy interventions that affect the trajectory of the endowment vector over a period of years. The distinctly new and difficult problems would arise in implementing the suggested social accounts and verifying their usefulness initially for a single period. For example, (34) implies that dollar values could be assigned to the current behavioral outputs of universities, government agencies, and scientific communities, as well as to those of business firms !

To say that such things are possible is not to say that they are easy or that they will soon be achieved. The gap between aspiration and accomplishment may be closed from either direction (pp. 41—42)."

2. Recurrent Tensions between Theorists and Empiricists, and Their Resolution

The Fox=Van Moeseke model just described stands at the theoretical end of the theorist-empiricist spectrum. However, it implies a set of operations which could actually be carried out by an intelligent individual who had made a New Year's resolution to spend his time wisely during the year ahead :

a. He should list the behavior settings in which he spent his time in the year just past plus some additional ones whose inclusion *might* make him better off in the year ahead;

b. He should estimate the proportions of his time that went into each behavior setting during the past year (those elements of the vector x for which $x_j > 0$);

c. He should list the resources he perceives as limiting his activities (income from property and transfer payments, health, skills) and the requirements that he must meet (repayment of debts, completion of a training program) in the coming year, namely the elements of the vector b;

d. He should estimate the proportion of each resource that would be used up and the proportion of each requirement that would be met per unit of time spent in each behavior setting (the elements a_{ij} of the matrix A);

e. Having specified A and b for the coming year and having reconstructed last year's actual x as a starting point (not theoretically required) from which to seek a new, optimal x for next year, the individual could use various computational devices to bring out the implications of his (unspecified) utility function, u(x). For example, he could assign numbers c_j from 10 (highest) down to 0 (lowest) to the rewards per unit of time he experiences or expects in the various settings x_j, $j = 1, 2, ..., n$; specify realistic upper limits on time to be spent on the more rewarding activities (e.g. meals) and lower limits on the less rewarding but necessary ones (e.g. sleep); and compute a linear programming solution that maximizes $\sum_{j=1}^{n} c_j x_j$. Some of the shadow prices, and hence some portions of the total value of rewards $\sum_{j=1}^{n} c_j x_j$, would be attributed to upper and lower bounds rather than to substantive resources and requirements; however, by specifying downward sloping segments $c_j = \alpha_j - \beta_j x_j$, equivalent to diminishing marginal utility of time spent in setting j, he could eliminate upper and lower bounds from the solution (which now involves quadratic programming) so that total rewards are attributed exhaustively to the substantive elements of b.

The acid test of whatever computing aids are employed is that the individual arrive at a time-allocation vector or *life style* x* which he cannot improve upon given his *endowment* b and his *environment* A. If at least one element of b is financial and has a nonzero shadow price, then equivalent dollar values can be attributed to each of the other elements and to the sum of all such values, the individual's *total income*. However, the main (and perhaps only) product of interest to the individual would be the vector x*, the "wisest way" to allocate his time according to his own value system; he might or might not be intrigued if an economist friend were to tell him he had chosen x* "as if" he valued his professional reputation at $5,000 a year and all his resources combined at $50,000 a year.

It is hard to visualize a contrasting empiricist approach to this problem of individual choice : if the individual has any preferences at all, various types of homely advice ("make a list of the things you like most and the things you like least;" "make a trial budget;" "decide what you want and then figure out how much of it you can afford") embody roughly equivalent theories. Contrasts may be found when theorists and empiricists respectively are asked to produce objective measures of well-being for groups of people, for example, the populations of two different cities.

Thus challenged, an empiricist might take whatever published data are readily available and convert them into index numbers (with or without the aid of factor analysis), reify the overall index as "the quality of life," and reify the various subindexes as "health", "education", "crime", "pollution", and "economic status". A pure theorist might not respond at all; a theorist who also has a flair for applications might examine the available data, select those measures which correspond to (or appear to be reasonable proxies for) variables required by theories of utility, consumption, and production extended to include social as well as economic variables, and report somewhat as follows :

(1) Useful comparisons can be made between the values of specified individual variables;

(2) it appears that a reasonable subindex of "economic status" can be constructed from the available data although certain additional variables should be included if and when possible;

(3) it appears that presently available measures of air pollution, water quality, noise levels, and their effects on human well-being do not justify the construction of an index of environmental quality;

(4) the relationship between health and hospital beds per 1000 persons under U.S. conditions may be either positive or negative and causation can run in either direction;

(5) valid objective measures of "the quality of life" are at least a decade in the future.

I believe the present tensions between theorists and empiricists in this field will be resolved by the adoption of a new paradigm which will bring the entire field into the mainstream of social science. When this happens, "social indicators" will be relegated to a very minor role; emphasis will shift to social data systems, comprehensive social accounts, and social system models; and a measure or measures derived from the comprehensive social accounts (perhaps "total income per person") will absorb most of the meanings now associated with objective measures called "the quality of life". Perhaps the latter term will then be given a clear-cut meaning in connection with surveys of people's subjective perceptions of their current situations and future propsects.

Similar tensions have existed at various times in the history of economics. Economists working on "economic indicators" in the 1920's were suspicious of formal theories of any kind. At the other extreme had been Pareto (died 1923). Ricci (1924), himself a capable theorist, paid tribute to Pareto's great accomplishments in pure logic but likened his theory to an enchanted castle from which there was no bridge to nine-tenths of the problems with which economists were usually concerned.

According to Henry L. Moore (1908), several of the great mathematical economists (Cournot, Jevons, Edgeworth, Pareto) had conceived of "an inductive statistical complement of the pure science" (p. 2). He cited with approval the following passages from Jevons' *Theory of Political Economy* (3rd ed.) :

"I know not when we shall have a perfect system of statistics. but the want of it is the only insuperable obstacle in the way of making Economics an exact science. In the absence of complete statistics, the science will not be less mathematical, though it will be immensely less useful than if it were, comparatively speaking, exact. A correct theory is the first step towards improvement, by showing what we need and what we might accomplish" (p. 12).

The deductive science of Economics must be verified and rendered useful by the purely empirical science of statistics. Theory must be invested with the reality and life of fact (p. 22).

Moore had entitled his article "The Statistical Complement of Pure Economics", and he set out to create it. He had read all the works of the major economic theorists; he proceeded to study statistics under Karl Pearson and to look for reliable time series data on prices, production, and consumption which, according to economic theory, should represent points on market supply and demand curves. His successes in estimating statistical demand and supply curves from such data stimulated younger economists and led to cumulative improvements in data systems and estimation techniques.

In his last book, *Synthetic Economics* (1929), Moore proposed an implementation of the general equilibrium model of Walras, the principal elements of which were to be comprehensive sets of empirical (statistically-estimated) demand and supply functions ! Moore's student Henry Schultz published one of the great classics of econometrics, *The Theory and Measurement of Demand* (1938), which took cognizance of the newest relevant developments in economic theory and mathematical statistics and applied them to more accurate and comprehensive data than had been available to Moore (the improvements had been stimulated directly and indirectly by Moore's own work). The agenda Moore proposed in 1929 was not really carried out until the 1960's, though the demands placed on our economic data systems by national income accounts (Kuznets, 1937), Tinbergen's (1939) econometric models, and Leontief's (1936, 1951) successively larger input-output models did much to prepare the way.

In the course of this econometric revolution, the earlier work on economic indicators was labeled "measurement without theory" by Koopmans (1947). Economic indicators in the earlier sense disappeared from the professional literature, though the term was sometimes applied to individual time series or index numbers believed to be helpful in predicting the *timing* of directional changes in major variables.

3. The Current Status of My Approach to Comprehensive Social Accounts

If the Fox-Van Moeseke model is taken as the starting point for social accounts applying to population aggregates (cities, regions, nations), it must be placed on an objective basis. In the subjective version, two individuals with identical resources but different utility functions would choose different time-allocation vectors, implying different sets of shadow prices for their resources. It does not seem wise to base a set of social accounts on the Pirandello principle ("right you are -- if you think you are"); in practice, we must evidently assign the same values to the same resources when found in different individuals in the same community or labor market. If the resources are sold in an actual market (e.g. an occupational skill, it seems best to value them at the going wage; if they are used in non-market activities, the same resources in different individuals should be assigned the same imputed values.

To save space and facilitate exposition, I shall describe my present approach in a series of numbered statements :

1. The *environment* of human behavior in a given year is exhaustively partitioned into spatio-temporal entities called *behavior settings* (see Barker, 1963, 1968).

2. No human behavior occurs outside of a behavior setting. Hence, a comprehensive array of behavior settings for the world as a whole in a given year contains *all* human behavior.

3. Since all human behavior occurs in behavior settings, any measurable changes or differences in behavior over time or between places must be measurable in behavior settings.

4. The behavioral contributions or inputs to a behavior setting by its occupants are made through *behavior mechanisms* (see Barker, 1968). These can be grouped exhaustively into four categories or domains : cognitive, affective, psychomotor, and gross motor (see, for example, Bloom, ed., 1956, Krathwohl et al, 1964, Harrow, 1972, and Durnin and Passmore, 1967).

5. To the extent that occupants of a setting contribute behavior inputs to it voluntarily, they may be assumed to receive rewards from the setting roughly equal in value to that of their behavior inputs. Hence, if equivalent dollar values can be attributed to the behavior inputs, the same values can be attributed to the rewards. The justification for this assumption is stated rigorously in connection with the Fox-Van Moeseke model of Section 1.

6. In any behavior setting, it is possible to assign a numerical rating to each of the four categories of behavior mechanisms based on the *tempo* and *intensity* with which it is used in implementing the *program* or *standing behavior pattern* of the setting and the proportion of total occupancy time in person-hours during which it is so used (the extent of *participation* among the setting's occupants), as described in Barker (1968). In principle, ratings for the setting as a whole are weighted averages of the corresponding ratings for its individual occupants who may be playing different roles requiring different combinations of inputs.

7. The demands imposed by each role in a setting on the behavior mechanisms of its occupant may be expressed as a vector of four numerical ratings (one for each of the four categories) called a *standard behavior input vector* or y-vector; each element in the vector has the dimension "quantity required per unit of time spent in the setting."

8. In principle, a y-vector can be specified for each role in an exhaustive set of classes of similar behavior settings called *genotypes;* all behavior settings in a genotype share a common program or standing pattern of behavior (e.g. Barber Shops is a genotype, Jones' Barber Shop is a behavior setting), as stated in Barker (1968).

9. In the United States, reasonable proxies for such y-vectors can be derived from the *Dictionary of Occupational Titles* or DOT (1965) and its *Supplement* (1966) for what Berwitz (1975, p. 44) calls "the 14,000 basic jobs comprising the nation's economy". As the 14,000 include professional athletes and performing artists, chauffeurs, housekeepers, and others who do for pay what most people undertake for exercise, prestige, recreation, or do-it-yourself economy, few roles in nonmarket organizations (including households) are without counterparts in the DOT and even those should be ratable by an adaptation of job analysis methods, as described in the *Handbook for Analyzing Jobs* (1972).

10. The time, t, spent by each role-occupant in a setting can be multiplied by each element in the appropriate y-vector to obtain a q-vector each element of which has the dimension "quantity", or

units of behavior input. The elements of these quantity vectors can be summed over the occupants of a behavior setting, or across the behavior settings used by an individual in the course of a year, or both.

11. The four elements in a q-vector will be stated in different, probably incommensurable, units. This poses an index number problem : if setting i absorbs more q_1 but less q_2 than setting j, which absorbs the larger total amount of behavior inputs ? We cannot say unless we are willing to assign "prices" or other (relative) weights per unit to each of the behavior input categories.

12. In countries with highly developed labor markets, it is possible on certain assumptions to estimate a price vector, p, by regressing the yearly or hourly earnings of workers in an exhaustive set of occupations upon the four elements of their respective q-vectors or y-vectors. If the four prices imply that a specified standard behavior input vector is worth \$ 5.00 an hour in the labor market, the same vector may be given an imputed value of \$5.00 an hour when it occurs in nonmarket settings.

13. Given exhaustive sets of standard behavior input vectors y, time-allocation vectors t, and a price vector p, it is possible to compute equivalent dollar values for all behavior inputs supplied in a given year by each population subgroup to each genotype or other aggregate of behavior settings. An illustrative calculation for a particular region in the United States as of 1969 led to an estimate of the total value of behavior inputs supplied to all settings by all residents *approximately five times as large* as the value supplied to the labor market alone.

In principle, such calculations should lead to consistent valuations of the contributions of different population subgroups to the same categories of behavior settings and to the totalities of the behavior settings they respectively occupy.

14. The behavior stream of any individual is structured into entities of relatively brief duration called *behavior episodes*, as described in Barker and Wright (1955) and Barker (1963). Behavior episodes are ecological units smaller in spatio-temporal extent than behavior settings and always occurring within them. In principle, all behavior occurring in a setting can be partitioned into behavior episodes; this approach may be useful in refining comparisons between similar behavior settings and between similar occupations or roles.

These fourteen statements describe the logical sequence I have followed during five years of work on a project entitled Measurement and Valuation of Social System Outcomes. Each link in the sequence poses researchable problems the solutions of which will require cooperation between experts in at least two data systems and at least two sciences, and validation of the sequence as a whole will require communication among all those involved in any of the links.

My research has been supported by the National Science Foundation and a liberal allowance of research time within the regular budget of Iowa State University. The results of this research are reported in a four-volume manuscript (Fox, ed., 1980) three volumes of which are now being reviewed for publication. I hope to extend these results substantially during the next three years.

Among other things, I should like to attempt the classification and valuation of *rewards* or *outputs* of behavior settings. In principle, the value of outputs should equal the value of inputs; if the two values are estimated independently, they should not be exactly equal but should show a "statistical discrepancy" whose size would give some indication of the quality of the data system as a whole.

It seems to me that the rewards produced in a behavior setting can be classified into *extrinsic* (carried away and consumed in other settings); *intrinsic* (associated with the program or standing behavior pattern common to all settings in a genotype); and *concomitant* (associated with the personnel, policies, and other attributes of a particular setting which are logically independent of the genotype program). Barker's *action patterns* help to characterize the purposes different genotypes are designed to serve (i.e., the demands they are intended to satisfy), and we have already outlined in Section 1 some implications of the Fox-Van Moeseke model for demand analysis. There is much still be to done.

4. The Significance of Roger Barker's Ecological Psychology as Part of a New Paradigm for Social Data Systems and Social Accounts

Differences between the philosophical implications of my present approach and the approaches of others concerned with social accounts consist largely in my adaptations of concepts from ecological psychology. I feel justified, therefore, in devoting some space to an elucidation of this still young, but no longer precocious, discipline.

In broad outline, it was conceptualized by Roger G. Barker and Herbert F. Wright in or before 1947; they published their first major book on the subject in 1955 (*Midwest and Its Children : the Psychological Ecology of an American Town*); and one of Barker's former students published the discipline's first textbook (Wicker, *An Introduction to Ecological Psychology*) in 1979. From an early stage in their collaboration, Wright specialized on detailed studies of the behavior streams of individuals while Barker specialized on behavior setting surveys of complete communities; as Barker's work is more directly relevant to social accounting, my exposition will refer frequently to Barker and only once or twice to Wright. I should add that Barker and Wright had become acquainted in the mid-1930's as members of the first group of postdoctoral research associates to work with Kurt Lewin after his arrival in the United States.

Ecological psychology is an eco-behavioral science which seeks to describe and measure naturally-occurring human behavior in complete communities, naturally-occurring in the sense that it is not influenced by an experimenter. Barker made repeated year-long surveys of a small county-seat town in Kansas (code-named Midwest) where he lived and worked as co-director of the Midwest Psychological Field Station of the University of Kansas from 1947 through 1972.

From my standpoint, Barker's strategic discovery was that the town as an environment for human behavior was exhaustively partitioned into spatio-temporal entities which he calls *behavior settings*. Examples would include grocery stores, high school mathematics classes, the county recorder's office, the Methodist Church's Sunday worship service, the Boy Scout troop meeting, and many others. He found 884 such entities in Midwest during 1963—64 exclusive of these occurring in private households; the 884 accounted for 1,880,730 person-hours of occupancy time during the year.

As a matter of policy and research focus Barker did not survey the households of Midwest, but he was confident that they also were partitioned into behavior settings. The result of including household behavior settings would be a complete accounting for all time spent by people in the town during the survey year. In fact, Barker and Wright (1955, pp. 97—98) estimated that during 1951—52 the town's residents had spent 5,130,000 hours in household settings, 1,030,658 hours in community (i.e. nonhousehold) settings, and 330,620 hours in settings outside the limits of the town.

Barker (1963) says that behavior settings are tough, highly visible features of the human habitat that can be identified without an explicit theory. From an eco-behavioral standpoint, a town *is* its behavior settings; no behavior takes place outside of a behavior setting.

It seems to me that the interests of several disciplines converge in behavior settings. All roles are played in them; all organizations are composed of them. Felson (1979) asserts that all sociologically interesting phenomena involving direct physical contact between persons occur in behavior settings, and that they appear to be ideal units for describing and modeling social processes. Behavior settings in nonmarket organizations are empirically valid analogs of the economist's markets. Small group phenomena occur in behavior settings; they can be viewed from the standpoints of group dynamics, transactional analysis, game theory, and the theory of teams. Kurt Lewin's concept of an individual's life space remains intact as the means by which a behavior setting secures the behavior appropriate to it.

Each individual in a setting can also be viewed as an organism in an environment-organism-environment continuum or E-O-E arc, a conception Barker (1968, pp. 137—139) attributes to Egon Brunswik. Brunswik used the E-O-E arc as a basis for classifying representative schools and problems of psychology; since Barker's ecological psychology, with behavior settings as a focal concept, encompasses the whole E-O-E arc *plus* environmental phenomena which shape and transmit influences from the termination of one arc to the origins of others, links between other social sciences and psychology can be established, tested, and evaluated in a behavior setting context.

Barker and Wright (1955, pp. 1—3) recognized that, in adapting procedures developed within the tradition of experimental psychology to the nonexperimental study of human behavior in communities, they were entering "the territory of the sociologist and the anthropologist without a passport, or a guide, or even a guide book" (p. 3). They viewed this aspect of their enterprise as one of *cross-disciplinary colonization*, applying a purely psychological approach — "psychological in a narrow, intra-professional sense" (p. 3) — to problems that had been of central concern to the other disciplines. However, their main objective was to fill a gap in psychological knowledge, "for in leaving out ecological methods psychology has almost completely omitted a basic scientific procedure that is essential if some fundamental problems of human behavior are to be solved" (p. 1).

Important works on ecological psychology by Barker and his associates in addition to these already cited include Barker (1965), Barker and Gump (1964), Barker and Schoggen (1973), Barker and Associates (1978), and Barker, Barker, and Ragle (1967).

5. Concluding Remarks

In his classic article on social systems accounting, Bertram Gross

(1966) cautioned that their development would take several decades; that it would require the participation of social scientists from many disciplines and the breaking down of many language barriers among them; and that in the process vast debates must take place.

I believe that these debates can be focused and progress in social accounting hastened by the adaptation and extension of ecological psychology. This discipline has now undergone 32 years of development and application by the psychologist Roger Barker and his close associates and students. It has the advantages of comprehensiveness, objectivity, and freedom from the vocabularies and preconceptions of economics, sociology, and most of psychology. I believe Barker's approach has, in principle, the capacity to classify, describe, and measure all of the normal, recurrent types of human behavior in any existing society, and it is with these types of human activities that social accounts will be mainly concerned.

Barker's approach does not require the acceptance of any explicit theory of behavior, motivation, or rational choice. It results in nonexperimental observations of, and in, naturally-occurring units of the *environment* of human behavior which he calls behavior settings. These are ecological units, and Barker views his discipline as an eco-behavioral science.

So far, it appears that Barker and his associates have not tried to link their concepts in a systematic way with those of social sciences other than psychology. My colleagues and I have made some progress toward this in the four-volume manuscript (Fox, ed., 1980) previously mentioned — three volumes currently under review and the fourth in preparation. At the least, it should clarify some of the questions that must be answered on the way toward a comprehensive system of social accounts. We believe such a system can be developed on a scientifically valid, statistically and economically feasible, and socially acceptable basis.

Such a system cannot be constructed, validated, and implemented all at once. Bertram Gross predicted that the process would take decades and require vast debates involving inputs from many disciplines. His predictions are on their way to fulfillment; our four volumes hopefully may reduce the number of decades (at least by a fraction of one) and help to delineate the solid edges of the debating platform from the surrounding fog.

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NOTES

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[1] Note that x records the proportions of the individual's time spent in each of the n behavior settings (a complete time budget), hence summarizes his life style. Each column of the matrix A lists the amounts of each of m (economic and social) exchange media absorbed per unit of time spent in a particular setting as an environment for the individual's behavior. The characterization of b as the individual's endowment is straightforward. (Fox (1974), p. 32 n. 2 — The editor)