Analysis
of
Psychosocial Development

Chapter VIII

Logic of Type Construction:
A Methodological Evaluation

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📖 342 [2]

Chapter VIII
Logic of Type Construction: A Methodological Evaluation

📖 343

INTRODUCTION

In this chapter we shall relate the accounting scheme of the psychologists, as we have extracted it by factor analysis (reported in Chapters IV, V, VI, and VII), to the structure of the general accounting scheme required by our frame of reference (Chapter I, with occasional references to Chapters II and III).

We shall evaluate the accounting scheme of the psychologists, and our procedures, using as our criteria three characteristics of a perfect accounting scheme. From this point of view we shall discuss problems of mutual exclusiveness of accounting categories, comprehensiveness, reliability, and validity. Departing from a discussion of objectivity, we shall formulate and attempt to estimate the bias expressed by the psychologists in their ratings.

The purpose of this study, the factor-analytic technique of data reduction, the structure of our conceptual scheme, and the necessity to employ a genetic mode of explanation in the analysis of psychosocial development — all these features of our study point to the development of typologies as a natural and necessary formulation of our findings. Since the theory of types is not sufficiently developed, we shall formulate a systematic methodological position on the meaning and use of types, and apply the criteria of a perfect accounting scheme as a test of the adequacy of our formulation. In the last section of this chapter we shall indicate some of the most salient typological characteristics of our findings and of our frame of reference.

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📖 344

THE ACCOUNTING SCHEME OF THE PSYCHOLOGISTS

All three domains that have been analyzed and reported belong to the Adulthood Panel of the Developmental Construct. They have been separated on parametric grounds from the fourth Domain of data available on the subjects, which also belongs to the Adulthood Panel. All three domains we analyzed are based on ratings by observers, while the fourth domain of tests is based on the results of the behavior of the subjects in an objective test situation, *i.e.,* not on rater responses, but on subject responses to instruments.

The analysis has shown, that the parametric differentiation of domains has not been rigorous enough: ratings by the psychologists and ratings by fellow subjects have been included into the same domains, yet showed a different pattern with respect to one of the factors. This led to a refinement of the distinction between domains, and results based on the ratings of the psychologists have been analyzed and interpreted separately from those based on ratings of fellow subjects.

The distinctions between the three domains of ratings are conceptual, and will be discussed in Chapter IX.

The factors as extracted and rotated are the categories of the accounting scheme, in the domains of ratings by psychologists, adulthood panel. They are accounting variables introduced artificially into the intercorrelation matrix, and correlated with the measures actually used. The correlations of the 📖 345 accounting variables (factors) and the measures are represented as factor loadings, and define the accounting categories operationally. On the basis of these operational definitions, factor scores for individual subjects can now be obtained. They will constitute the entries in the accounting scheme, describing the state of the subjects in adulthood, as it appears under the parametric condition of rating by psychologists.

📖 346

CHARACTERISTICS OF A PERFECT ACCOUNTING SCHEME

We can evaluate the accounting scheme of the psychologists by comparing it with a perfect accounting scheme.

A perfect accounting scheme would consist of accounting categories that would record the results of the operations of selection, by measurement, of such attributes of phenomena as are relevant within a given frame of reference. The procedures of selection are called selective operators, and we shall denote them by the symbol S. The ideal accounting scheme would have three characteristics.

First, entries in one category would not duplicate entries in any other category. The categories would be mutually exclusive, or non-overlapping, *i.e.,*

$$Si \,.\, Sj = 0 \,. \qquad (1)$$

Second, the categories together would account for all that is relevant in the phenomenon within a given frame of reference. The accounting scheme would be comprehensive, and the categories collectively exhaustive, *i.e.,*

$$S_1 + S_2 + S_3 + \ldots + S_n = I \,, \qquad (2)$$

where I stands for the total system.

Third, the operations would yield same results, no matter how often they are repeated. The results would be replicable, *i.e.,*

$$S_i^n = S_i \,, \qquad (3)$$

347 where S_i is a particular selective operation, and S_i^n the same operation repeated the n-th time.

An accounting scheme satisfying the three conditions defined by equations (1), (2), and (3)[3] would fulfill several ideals of the scientific method. Equation (1) represents the ideal of parsimony. Equation (2) represents the ideal of a natural system, *i.e.,* a system that has all the categories necessary and sufficient to account for a particular phenomenon within a given frame of reference. The requirement of idempotency, expressed in equation (3), together with requirements (1) and (2) would assure the conservation of some quantity throughout the system.

348

MUTUAL EXCLUSIVENESS OF ACCOUNTING CATEGORIES

The accounting scheme of the psychologists, as we have formulated it, satisfies equation (1). This was accomplished by extracting orthogonal, *i.e.,* non-overlapping or mutually exclusive factors. We can thus write

$$S_A \,.\, S_B \,.\, S_C \,.\, S_{IV} \,.\, R = 0 \,, \qquad (4)$$

where S_A, S_B, S_C stand for factors A, B, and C; S_{IV} stands for the fourth factor other than A, B, or C in each of the three rater domains; and R stands for residual variance that is also orthogonal to the factors.

[3] A set of selective operators that satisfies equations (1), (2), and (3) is called in physics a spectral set. For a discussion of some properties of such sets that are not discussed here, and for good illustrations, *cf.:* EDDINGTON, SIR ARTHUR. (1959). *New Pathways in Science.* Ann Arbor Paperbacks. Ann Arbor MI: The University of Michigan Press.
Ch. XII, section III, pp. 263-267.

349

Comprehensiveness

The extent to which we have satisfied the second criterion of comprehensiveness is indicated by the estimates of scope, computed earlier for each of the extracted factors. We can substitute in equation (2) components of variance extracted and write

$$S_A + S_B + S_C + S_{IV} + R = I \,. \qquad (5)$$

I stands here for the total variance represented in each domain. Estimates of variance, accounted for by the orthogonal factors A, B, C, and IV, together with residual variance R, add to total variance. Factors A, B, and C account for 59% of the total variance in the three domains.

350

Reliability

The requirement of idempotency (equation (3)) implies in a general way the requirements of reliability, objectivity, and validity. Let us first consider what lack of idempotency means. A common sense answer would be, that it means that the operator has changed, or that the phenomenon has changed. The phenomenon could have changed as the result of the previous operation, or for other reasons.

For our purposes we are especially interested in the case when the results of repeated operations vary due to the effect of repeated operations, which themselves have not changed. A selective operator that behaves this way, and therefore violates equation (3), we call a fractionating selective operator, and symbolize it by F. For fractionating operators

$$F_i^n = {}^{\sim}(F_j) \,, \qquad (6)$$

i.e., the result of the n-th fractionating operation of the i-th kind does **not** equal the result of an other operation of the same kind.

Now we can attribute all changes in the results to the *effect* of the selective operator, and not to spontaneous changes of the phenomenon or of the operator. It is only necessary to regard all possible sources of change in results as parameters operating on the selective operator, transforming it sometime from a pure selective operator for which equation (3) holds, to a fractionating selective operator for which equation (3) does not hold, and equation (6) does. Those *351* selective operators that yield the same results under varying parameters (conditions of measurement) are clearly idempotent.

In general, we call a selective operator reliable, if it remains idempotent under trivial changes in parameters (conditions of measurement). What changes are trivial is, of course, a matter of theory. If the results of selective operations change only under non-trivial changes in parameters, we must find a way to decide, whether the operation is by itself fractionating, or whether the changes in results are due to changes in the parameters. Such a decision is especially difficult if the change in parameters involves time, since then we have the possibility that changes in the phenomenon are due to time, as well as that they are due to repeated measurement (fractionation). This is the central methodological problem of longitudinal design.

The discussion of the accounting scheme has so far touched upon several *methodological problems in longitudinal research,* which can now be expressed more precisely in terms of the three requirements of the ideal accounting scheme.

The requirement of idempotency points to the difficulty of distinguishing between unreliability of measuring instruments, fractionation (*i.e.,* the effect of repeated measurements on the phenomenon), and process (*i.e.,* changes in the phenomenon due directly to non-trivial changes in the conditions under which measurement occurs).

352

The requirement of mutual exclusiveness of accounting categories points to the problem of detecting the first type of development we are interested in, namely change in the structure of the system. An accounting scheme adequate to the restructured system would no longer satisfy equation (1).

The requirement of collective exhaustiveness of the categories points to the difficulty of detecting the second type of development of interest, namely the disappearance or emergence of necessary accounting categories (state-variables). If a state-variable is no longer necessary for the determination of the state of the system, an accounting category simply becomes trivial. But if a new state-variable becomes necessary, equation (2) is violated. An accounting scheme that contains potentially trivial categories permits us to observe the possible fluctuation in the amount of variance accounted for by the category under varying parametric conditions. However, a scheme that lacks categories that later emerge is inadequate.

The awareness of these methodological problems led us to the adoption of an inductive approach to the construction of the accounting scheme for the study, as well as to the selection of factor analysis as a method. Factorial analysis can potentially cope with the problems of disappearance and emergence of non-trivial accounting categories by extraction of different sets of factors in different domains. It can also cope with the problem of change of structure of the system, in that congruent factors (accounting categories) in different domains may in one *353* domain be orthogonal (mutually exclusive) while in another domain they may be oblique (overlapping).

354

Objectivity

The problem of *objectivity* has, from the point of view we have adopted, a form similar to that of the problem of reliability. The parameters that are relevant are the observer parameters. If the results of the same selective operation performed by different observers are the same, we attribute the result to the phenomenon (object) and not to the observers (subjects). Our criterion of objectivity is then

$$(O_j)S_i = (O_k)S_i \,, \qquad (7)$$

where S_i stands as in previous equations for a selective operation i, the parentheses enclose parameters, O stands for observers, and subscripts $_j$ and $_k$ indicate that different observers are performing operation S_i. Equation (7) thus defines objectivity as inter-subjective invariance.

Let us assume that S_i is a reliable measure. If it remains invariant under non-trivial changes in observers, we call the observers objective. If changes in observers lead to different results, and thus violate equation (7), we call the observers biased. If we now could estimate the impact of the bias on the result of the measurement, we could restore objectivity by an appropriate compensatory transformation of the result of measurement. The measurement would then be invariant under observer-transformations and the requirement of idempotency expressed in equation (3) would be again met.

355

The bias of the psychologists

We can now formulate in these terms the bias of the psychologists, which was detected in this study. The Domain of Role Expectations contains the results of selection of subjects for a set of nineteen roles by two groups of observers: the psychologists and the fellow subjects. The results of the analysis of the domain clearly indicate that both groups of observers used three non-overlapping selective operators, A, B, and C. These were further shown to be congruent in content and structure to factors A, B, and C in the other two domains. The parametric differences in the selection procedure can be regarded as trivial, except for the non-trivial differences between the observers. One group of observers were professional students of behavior, who themselves were not subjects of study, and ten out of eleven were men. The other group of observers were educated, but psychologically untrained subjects, all of them women. They were selecting fellow subjects, while being simultaneously considered by them.

The results of the selection can be expressed in two equations:

$$(ST)S_{BxC} = (AL)S_{BxC} \qquad (8)$$

and

$$(ST)S_A = \sim((AL)S_A) \,. \qquad (9)$$

In both equations, in accordance with the convention used previously, parentheses enclose parameters, ST stands for staff psychologists, AL stands *356* for fellow alumnae subjects, S stands for the selective operation, subscript $_{BxC}$ stands for orthogonal factors B and C, while subscript $_A$ stands for factor A.

Equation (8) thus asserts that the results of the selective operations B and C were approximately equal both in magnitude and structure (orthogonal) when performed by the psychologists and by fellow subjects. This meets our criterion of inter-subjective invariance, as expressed in equation (7).

Equation (9) asserts that the results of the selective operation A were different when performed by the psychologists and by the fellow subjects. The requirement of objectivity (equation (7)) is thus violated, and since we have no reason to believe that operator S_A is fractionating, we must attribute bias to either or both groups of observers.

We have attributed the bias to the psychologists, and not to the subjects on the basis of both accounting and conceptual inference. Both kinds of inference were made before we have discovered the lack of invariance in the results obtained by operation S_A in the Domain of Role Expectations by the two different groups of observers.

The accounting inference stems from an evaluation of systematic irregularities in the quantitative results in all three domains. In each domain, the distribution of items in the factor space is quite anomalous. One forms a vivid impression of a relatively homogeneous three-dimensional distribution that has been torn apart along the axis coinciding with factor A. This is, however, only the case for 🕮 *357* those items that represent ratings by the psychologists. Furthermore, factor A accounts in each domain for about three times the amount of variance accounted for by factors B, or C. This again is the case only for variables rated by the psychologists. Factors A, B, and C account for roughly similar amounts of variance on variables rated by fellow subjects.

The conceptual inference is based on qualitative differences between the items that load highly on A and those that load highly on B and C. All the measures or indices of liking, positive evaluation, and preference by the psychologists are among the highest and purest loading items on A+. The content of most of the other items with high and pure loadings on A+ describes, in similar terms, what Nunberg[4] has authoritatively defined as the goal of psychoanalytic therapy; namely, a concomitant increase in the mobility of the Id, in the tolerance and flexibility of the Super-Ego, and in the synthesizing power of the Ego. The opposite post, A-, has been interpreted as fixation, rigidity and inflexibility, lack of autonomy, and constriction of life space. The present writer believes, that the assessment psychologists use this *moral ideal,* most explicitly formulated in psychoanalysis, as their first criterion of evaluation. It is only in this sense that they are biased. However, it is necessary to point out quite emphatically, 🕮 *358* that this in no way implies that they have a *theoretical* psychoanalytic bias. Indeed, they share with the subjects the same categories of evaluation. No bias on the part of the psychologists is detectable relative to factors B and C. It goes, perhaps, without saying that the moral ideal that has been formulated as the goal of psycho-

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4 NUNBERG, H. (1931). The synthetic function of the Ego. *International Journal of Psychoanalysis,* vol. 12, pp. 123-140.

analytic therapy is not exclusively dependent on the psychoanalytic theory of personality. Rather, it is a general humanistic ideal that has been disseminated by the cultural influence of psychoanalysis, at least among most social scientists.

If the above reasoning is correct, we can roughly estimate the amount of variance accounted for by SA that is due to the bias of the psychologists by substituting estimates of variance in

$$(ST)S_A - (AL)S_A = (ST)B_A \,, \qquad (10)$$

where the term $(ST)B_A$ stands for the bias of the staff psychologists with respect to characteristic A of the subjects. The rough estimate obtained by formula (10) would place the scope of the bias of the psychologists in the order of 15-20% of total variance.

The problem of the objectivity of observers reappears in a more subtle way when we apply the criterion of idempotency (equation (3)) to the criterion of comprehensiveness (equation (2)). The problem thus stated is one of differential capacity of observers to measure reliably all the state-variables that are necessary for an exhaustive description of the state of the system. With the 🕮 *359* inductive approach that has been adopted, we are likely to encounter variations between domains in the fraction of total variance that is accounted for by the same, or different numbers of factors. From this point of view, part of the difference between the ratings of staff psychologists and fellow subjects may be due to the better capacity of the psychologists to estimate characteristic A. When such an observer bias in comprehensiveness operates, we can falsely attribute the change in the number or kinds of categories that account for a given fraction of the system to development of the second kind, namely, emergence or disappearance of necessary state-variables. Such a bias does not seem to operate between the domains of ratings.

Bias may also enter with respect to the criterion of mutual exclusiveness of categories (equation (1)). Observers may differ in their analytic ability, *i.e.,* ability to distinguish between non-overlapping selective operations. Thus an apparent development of the first kind, namely a restructuring of the system, may be in fact due to structural observer bias. Our results indicate that such bias does not operate in the domains of ratings, at least so far as the two groups of observers are concerned.

🕮 *360*

VALIDITY

The last issue pertaining to the accounting scheme that we need to discuss before we turn our attention to the conceptual scheme is the issue of *validity.* This issue involves questions relating to the idempotency of different selective operators that define an accounting category, as well as questions about the nature of the relationship between accounting and conceptual categories.

Radical operationalism, as formulated by Bridgman,[5] disposes of the problem of validity in the following manner: Concepts are defined operationally, by the exact description of the procedure and conditions of measurement (*i.e.,* by a selective operator and associated parameters). Concepts and procedures of measurement are related one to one and directly, *i.e.,* for every different operation we need a different concept. Explanation schemes are coordinated directly with the procedures of measurement. Thus the question of whether the result of a procedure is a valid measure of a concept does not arise, since the concept is only a name for the procedure of measurement.

The structure of our frame of reference differs from a radical operationalist in two respects:

- While the categories of our accounting scheme are operationally defined, the relation between the actual procedures of measurement 🕮 *361* and the accounting categories is not one-one, but many-many. In the strictest sense, the accounting category is the extracted factor. The actual measures are correlated with several factors.
- Between the accounting scheme and the explanation scheme, we have a mediating but independent conceptual scheme. The conceptual categories are defined primarily syntactically in relationship to each other, and are linked to the accounting categories by interpretation. (Further, the formal categories of the explanation scheme are linked to the categories of the conceptual scheme by lexical definitions, and the formal operations of the explanation scheme operate thus primarily on the conceptual categories.)

The question of validity has two separate aspects. Each is related to one of the two differences between the structure of our frame of reference and a radically operationalist one.

The first aspect of the problem of validity is related to the issue of whether accounting categories can have more than one operation of measurement as their definition. The problem appears to be one of internal consistency of the measures. As long as the different measures of the same accounting category are idempotent, *i.e.,*

$$S_i'' = S_j' , \qquad (11)$$

we can regard them as equally valid measures of the same accounting category S_j. Even if their results are *systematically* both different and related, we can restore idempotency by appropriate compensatory transformations. But if we get 🕮 *362* unrelated results, the problem of validity arises. Sometimes we handle the problem by creating new accounting categories, and interpret these by different concepts, *i.e.,* we adopt the operationalist solution to the problem of validity. But this does not answer the question: Which, if any, of the several procedures provides a valid measure of the original concept?

It seems that until we have a unified system, where operations of measurement, accounting categories, conceptual categories, and formal explanatory operations are defined tautologically by each other, this question can be

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5 BRIDGMAN, P. W. (1938). *The Logic of Modern Physics.* New York NY: The Macmillan Company. Pp. 1-39.

only answered by an arbitrary preference for one procedure of measurement over an other.

The idea of *ecological validity,* formulated by Brunswik,[6] suggests that the preference could be stated in terms of parameters of measurement. It revives the old distinction between phenomena that occur *in vitro* and those that occur *in vivo.* According to this point of view, the closer the parameters (conditions of measurement) are to those of the 'natural habitat' of the phenomenon, the more valid is the measurement. The validation of a rating or a test against 'an external, behavioral criterion' is implicitly based on this kind of reasoning. But does this say any more than that a measure is valid, to the extent that it remains invariant under changes in parameters that pertain to the distinction between artificial and 🕮 *363* natural conditions for the occurrence of the phenomenon and for measurement?

If we were to adopt this approach, we would need to classify the data we have on our subjects in terms of increasing naturalness of the conditions of measurement. But this is easier said than done. Shall we regard the ratings by trained psychologists based on three days of observation in an assessment situation as less or as more ecologically valid than the responses of the subjects in the same situation to paper-and-pencil tests, to experimental tasks, and to sometime highly artificial assessment procedures that are self-scoring?

The solution in terms of ecological validity seems relevant only when the purpose of the investigation is to find procedures of measurement, which could be applied in artificial situations and used to predict the behavior of subjects in natural situations. Thus ecological validity becomes a special instance of the criterion of predictive success of an instrument. In studies, such as ours, where the purpose of the investigation is exploration and description, this approach to validity does not seem relevant. The best we can do is to find sets of measures that are internally consistent within a domain, and externally consistent across domains.

The inductive approach to construction of accounting categories, that has been used in this study, has followed the operationalist solution to the problem of validity in one respect: for every set of measures that behaved in an 🕮 *364* internally consistent way, an accounting category (a factor) has been constructed.[7] The validity of the measures has been also tested by the criterion of external consistency (by the test of congruence across domains). This has been done without any assertion that the measures in one domain are 'more valid' measures of some common concept than measures in another domain. If, in future research, the categories of the rating domains are to be compared with the categories of the domain of objective tests, such proce-

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6 BRUNSWICK, E. (1947). *Systematic and Representative Design of Psychological Experiments.* Berkeley CA: University of California Press.

7 More precisely: non-overlapping and internally consistent components of variance of overlapping sets of measures have been compounded into non-overlapping factors.

dure should be regarded as a cross-validation under the criterion of external consistency, but not as a test of ecological validity.

We have discussed three possible solutions to the problem of validity, as it arises if we use more than one procedure to define operationally an accounting category.

The radical operationalist solution is to have a different accounting category, and a different concept, for every operation of measurement.

The second solution is by preference for one measure or for measurement under special conditions. Validations by an external behavioral criterion, by ecological validity, or by predictive adequacy were cited as special cases of this solution. Agreement of other procedures of measurement with a preferred 🕮 365 procedure is regarded as an index of the validity of the various operations.

The third solution, adopted for this study, is in terms of internal and external consistency of a set of operations. For each set of operations that are internally consistent within a domain, we establish inductively an accounting category. The accounting category is linked by interpretation to a concept. Concepts in two different domains may be regarded as instances of a more general concept. We can test this hypothesis by examining whether the operations of measurement associated with the two relevant accounting categories in the two domains are externally consistent with each other. If they are not, we reject the hypothesis. Or, we regard one or both sets of measures as invalid.

Unfortunately, we can have it either way. Thus the above procedure does not solve the problem of validity. The problem reappears in the area of the second difference between the structure of a radically operationalist frame of reference and the structure of our frame of reference. This is the problem of the relation between concepts and accounting categories, the problem of interpretation, or the problem of *face validity.* No matter which of the three solutions discussed above we were to adopt, so long as we grant concepts an existence independent of measurement, we are faced with the question: How do we know whether a particular procedure of measurement is valid for a given concept? The answer seems to be that the decision whether an event is an 🕮 366 instance of a concept is an irreducible matter of fundamental, subjective judgment. There is no known logical or physical operation that can substitute for such subjective judgment.[8] The only possible solutions to this problem seem to be decisions by fiat, by tradition, by authority, by consensus, or by various possible combinations of these. Such decisions are clearly inconsistent with the scientific method, and their adoption serves only to hide the problem, not to solve it. The problem of proof of face validity seems to be one of the weak spots in the harness of the scientific method.

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8 Until a tautological unified system, referred to earlier, is constructed. This, of course, is the crowning achievement of a science.

367

TYPES AS ACCOUNTING CATEGORIES

Factorial analysis of empirical data readily becomes a technique of inductive construction of typologies. This is especially so when the analysis is aimed at the extraction, from conceptually defined domains, of orthogonal factors rotated into conceptually determined orientations.

Our frame of reference presupposes the use of types as accounting categories linked by interpretation to elements of the conceptual and explanatory schemes.

Before we attempt to evaluate the results of the empirical study as a contribution to the construction of empirically based psychosocial types and types of psychosocial development, we must define, as clearly as we can, the construct "type."

This is especially necessary, since, despite of the long history of the use of type constructs in the behavioral sciences, and despite of some recent contributions[9] to the theory of types, the meaning of this construct still seems to be characterized by a certain vagueness and ambiguity, and its methodological and epistemological status remains uncertain.

368

For the purposes of this study, we shall regard types as special accounting categories, constructed in order to condense and combine information (data) for a given set of desired conceptual or explanatory manipulations or comparisons. Viewed this way, the meaning of 'types' as methodological and epistemological devices will have to be established by operational definitions.

In general, we shall define a type as an accounting category for a non-trivial subset of values or transformations $\{0 \in I\}$ of a complex variable.[10]

For a more complete definition, we must distinguish between

- conceptual and explanatory types;
- arbitrary and non-arbitrary types; and
- natural and ideal types.

369

CONCEPTUAL AND EXPLANATORY TYPES

Any non-trivial sub-space of a space defined by a set of coordinates can be regarded as a *conceptual type* with respect to the set of variables that are in-

[9] Especially: HOLZNER, B. AND RHOADS, J. K. (1961); LYKKEN, D.T. (1956); VON KEMPSKI, J. (1952); GRELLING, K. AND OPPENHEIM, P. (1938). For additional points of view, *cf.* HEMPEL, C. G. AND OPPENHEIM, P. (1936); HEMPEL, C. G. (1952); BECKER, H. (1950) and (1958); BRODBECK, M. (1959); RUSTOW, A. (1952).

[10] An interval (a bounded range of values) on one (simple) variable is thus the most degenerate instance of a type. Our discussion will concern the general case.

terpreted as the coordinates of the space. The sub-space may be finite or infinite, and fully or partially bounded. The accounting category corresponding to the conceptual type includes the set of vectors whose origins coincide with the origin of the set of coordinates and whose terminal points lie within the sub-space. When resolved into component vectors, the terminal points of the components will fall within a range of values of the coordinate variables that is at least partially bounded. Thus conceptual types are defined and distinguished from each other in terms of the constituent *variables* (coordinate space) *and their values.*

Explanatory types distinguish between the *values of the relationship* between variables. (The variables may, but need not, be enumerated. They also may, but need not, be specified.) Thus an explanatory type would specify the nature of the coordinate space (its obliqueness, curvature, and acceleration) necessary for, e.g., a linear representation of the relationship. If expressed as a tensor, the relationship would remain invariant under any transformation of the coordinates. Ultimately, then, an explanatory type as an accounting category includes a tensor (or a set of tensors) that would represent the value of the relationship under any transformation of the coordinates.

370

Defined in this way, both conceptual and explanatory types become simply accounting categories, *i.e.,* they only enable us to classify and count occurrences. To test hypotheses, a combination of a conceptual and an explanatory type is required. Any hypothesis involving types would have the basic form: “Whenever instances of a conceptual type C' occur, transformations (relationships) between them will be of the explanatory type E',” or vice versa, “Relationships of type E' will only occur between occurrences of type C'.”

371

ARBITRARY AND NON-ARBITRARY TYPES

Both conceptual and explanatory types are used as accounting categories in order to condense information (data) for a given set of analytic purposes. The condensation is accomplished by a decision to treat as equivalent a subset of non-equivalent results of measurement. The same decision excludes as non-equivalent other results.

Let us first consider the case of the conceptual types. The procedure is identical to one in the degenerate case of establishing intervals on a scale that are courser than the sensitivity of the measuring instrument. The central problem concerns the nature of the criterion for imposing discontinuity on a variable (or space) that is initially conceived of as continuous. There are several accepted techniques for imposing arbitrary discontinuity, such as rounding off procedures, percentaging, use of fractions of the standard deviations, and psychometric techniques of estimating just noticeable differences for establishing the magnitude of the intervals. Types constructed on the basis of such arbitrary procedures (such as 'extreme types' or the usual 'high-middle-low types' of personality psychology), although operationally defined, are justifiable only as heuristic devices. If the only basis for imposing discontinuity, and thus typing, turned out to be arbitrary or conventional, the methodological and especially the epistemological status of types as accounting categories would be open to serious doubt. Let us therefore explore the possibilities of 🕮 372 non-arbitrary criteria for establishing the boundaries of types.

The first such criterion is empirical. In a pronounced multi-modal distribution, it should be possible to establish satisficing criteria for the probabilities of both type I and II errors, and to distinguish between ranges of relative certainty and ranges of uncertainty for type membership. This would impose a discontinuity on the attribute space, such that regions of high incidence of pure types would be separated by regions of low incidence of mixed (uncertain) types. The extreme case of such a discontinuity would be a complete absence of occurrences in the mixed type regions.[11]

A perfectly non-overlapping distribution would, of course, satisfy one of the requirements of a perfect accounting scheme as expressed in the equation

$$S_i \cdot S_j = 0 \, . \qquad (1)$$

Non-arbitrary conceptual types would acquire the status of pure selective operators, as far as the requirement of non-overlap is concerned.

The parameters of overlapping multi-modal distributions, used in the way suggested above, would enable us to estimate whether a given distribution deviates from the requirement of non-overlap by an amount acceptable for a given analytic purpose. Such non-arbitrary criterion for establishing the boundaries 🕮 373 of types would put the type as an accounting category on a solid methodological basis.

The above considerations suggest an approach to the non-arbitrary imposition of discontinuity, which is of considerable epistemological interest. A multi-modal distribution implies the possibility of different types of relationships between the variables that would explain (produce) such distribution. Thus a non-arbitrary set of conceptual types could be viewed as a set of phenotypes, and suggest a search for a set of genotypes as its proper explanation.[12] The different genotypes would correspond to different explanatory types.

There exists indeed a purely logical criterion that can be used to establish non-arbitrary boundaries between conceptual types. If different explanatory

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[11] Such as the discontinuity observed in sub-atomic physics, which permits the use of explanatory, besides descriptive, statistics.

[12] Such genotypes would, of course, vary in one or both of two respects: in the nature of the relationships between the variables, or in the nature of the variables between which such relationships obtain. The problem of the two kinds of difference has been treated in detail in Chapter II, in the section on "Categories of Change." The problem of the necessary and sufficient variables will be dealt with on the following pages.

types (different values of the relationship) exist for different ranges of values of the same set of variables, these ranges define the component values of the conceptual types.[13]

🕮 375

When a one-to-one correspondence between a set of conceptual and a set of explanatory types is established (or hypothesized) for a given set of variables, all values within the boundaries of a conceptual type imply equally the one corresponding explanatory type. Thus any value within the relevant range of a type-constituent variable will imply the same kind of relationship to the other type-constituent variables. Therefore, instances of the same conceptual type, despite the variations in their (vector) values, will be idempotent as selective operators yielding the same explanatory type. This satisfies, for non-arbitrary conceptual types corresponding to explanatory types, the requirement of idempotency expressed earlier in equation

$$S_i^n = S_j \, , \qquad (3)$$

where S_j is now interpreted as an instance of a non-arbitrary conceptual type and the superscript ^{n} stands for any other instance of the same type different in vector value (within the range of permissible variation of values which defines the boundaries of the type).

We have already stated, that an explanatory type expressed as a tensor will maintain the invariance of the relationship between a set of variables under any transformation of the variables (coordinates). A transformation of the coordinate system requires a different conceptualization of the variables, and the same phenomenon assumes different values. Thus such transformation produces a new, different, set of conceptual types. If, however, the initial conceptual types 🕮 376 were non-arbitrary, and one-one correspondence between the conceptual and an explanatory typology exists, the transformed conceptual typology will be in a one-one correspondence to the initial one. The same explanatory type remains associated with equivalent non-arbitrary conceptual types within different (transformed) conceptual typologies. Thus the explanatory type becomes an idempotent selective operator in that it identifies equivalent non-arbitrary conceptual types despite of any transformations of the coordinate system.[14] This satisfies, for the explanatory type corresponding to a non-arbitrary conceptual type (in at least one coordinate system), the requirement of idempotency expressed in equation

$$S_i^n = S_j \, , \qquad (3)$$

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[13] Where different explanatory types are associated with different ranges of the same set of variables, one would expect a multi-modal distribution on at least one of these variables.
An important methodological principle can be derived from the above considerations: If the distinctions between conceptual types are arbitrary, there is no objection to the use of techniques which describe by a uniform function the relationships between the variables for all ranges of their values. When, however, the distinctions between the conceptual types are non-arbitrary, there is a clear implication that different relationships between the same variables will exist within each conceptual type. Thus separate analyses of the relationships within each conceptual type are indicated.

[14] A transformation of the coordinate system may result in the phenotypic disappearance of multi-modality of distributions, but non-overlap between conceptual types (corresponding to explanatory types) would be preserved. The principle of conservation of non-overlap implies the superiority of genotypic derivation of conceptual typologies over a purely empirical phenotypic derivation.

where S_j is now interpreted as a non-arbitrary conceptual typology corresponding to an explanatory typology, and the superscript ^{n} as any transformation of the conceptual typology.[15]

377

If then a corresponding explanatory typology is known, it can be used to produce equivalence between different non-arbitrary conceptual typologies. To the extent that such equivalence between different typologies is established, differences between conceptual typologies (phenotypic taxonomies) that may have been previously attributed to differences (or changes) in the phenomena are revealed as due to difference in the orientation of the observers (coordinate systems).

In this study, the known (unanalyzed) explanatory relations are embedded in the covariance matrix on which factor-analysis has been performed. Even if a different method for locating the origin of the coordinate system had been used, or if oblique rather than orthogonal factors had been extracted, or if the extracted structure had been rotated into a different orientation, only different conceptual types would have occurred. The (unanalyzed) explanatory types would have remained unchanged.

This invariance, retained in the covariance matrix, enabled us to perform the various heuristically and conceptually dictated rotations without distorting the relationships between the variables. But the theoretical importance of underlying explanatory invariance appears only when we consider the problem of congruence and more complex forms of relationships between domains that have been factor-analyzed and conceptualized separately.

We assume such explanatory invariance in our attempts to formulate the
378 relationships between conceptual types (phenotypes) in analytically, chorologically, or chronologically separate domains. We encounter the problem of independently formulated phenotypes not only in this study, but in one form or another in any attempt to explain relationships between ratings, objective tests, and ecologically valid behavior; between need-, value-, and role-orientations or other analytically separated domains of behavior; or between domains of behavior separated in time or space. Each such comparison is a search for explanatory types (genotypes) that would render equivalent the different conceptual typologies (phenotypic taxonomies) and explain differences between them ultimately as differences in the temporal, spatial, and analytic bias (orientation) of the observer.

[15] In this interpretation, we are expressing an extremely strong requirement of idempotency. Initially, we required idempotency only for the transformation of a single selective operator, *i.e.,* the same variable repeatedly measured. When discussing idempotency of non-arbitrary conceptual types, we added the requirement of idempotency of any value of the transform within a range. In the case of idempotency of explanatory types, we simultaneously require: (a) idempotency of the transformations of a whole set of selective operators (coordinate system), and (b) idempotency of their transforms within non-arbitrary ranges (non-arbitrary equivalent conceptual types).

🕮 *379*

NATURAL AND IDEAL TYPES

At the very beginning of this study[16], we have rejected the view that there exists a unique, natural frame of reference for each phenomenon, dictated solely by the phenomenon itself. Instead, we suggested that the frame of reference is determined by criteria derived, generally speaking, from the purposes of the investigation. A natural frame of reference, in our terminology, would be one that defines the phenomenon adequately for a given analytic purpose.

Earlier in this chapter[17], we had again to touch upon this issue when discussing the problem of ecological validity and a natural environment. It seems that in order to arrive at a definition of 'naturalness' that is useful for scientific inquiry, we have to examine the problem not from an ontological, but from an epistemological point of view. Thus viewed the problem of 'naturalness' reduces to a problem in contextual analysis.

Whether we wish to talk of natural frames of reference, natural systems, natural sets, or natural types, we have to consider three sets of parameters that are outside of the attempted formulation: (1) the unknowable 'reality' underlying the manifestations which we call the phenomenon; (2) the 'cultural' context of the analysis, *i.e.,* the purposes and formats, invoked by the analyst, which define the phenomenon; and (3) the empirical context in which the new defined phenomenon is regarded as embedded, *i.e.,* its environment.

🕮 *380*

Let us at first take into consideration only the first and second parameter of definition, *i.e.,* the 'reality of the phenomenon' and the 'cultural purpose of the definition.' Let the cultural purpose be a deterministic explanation of the phenomenon. The natural system then would be *that necessary and sufficient set of variables and of relationships between them, which would permit to derive* from the state of the system at *one* time its state at *any* time. (For other cultural purposes, such as, e.g., a functional, a stochastic, or a developmental explanation, the last, non-italicized part of the above sentence would be different.)

Now, the above definition implies an isolated system, *i.e.,* a system independent of its environment. Since, as was pointed out earlier, the only actually isolated system we can conceive of is the whole universe, any subsystem in the universe can be only isolated analytically, or virtually. (Virtual isolation reduces the empirical effect of the environment to values that fall within acceptance limits derived from the purpose of the inquiry and/or from the limitations of the accounting or explanatory operations.) Thus any system other than the total universe is natural only when considered in the

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[16] P. 43.

[17] Pp. 362 ff.

context of an *ideal* environment. An ideal environment is related to the system only by null-functions, *i.e.,* constant effects that can be neglected in the analysis of the system.

Conversely, considered in a *natural* environment, such system becomes an *ideal* system in that it no longer accounts for all the variables and relationships 🕮 *381* necessary and sufficient to accomplish the purpose of the inquiry.[18]

Thus the decision as to the naturalness of a system depends not only on the reality directly underlying the phenomenon, and on the cultural purpose of the definition of the phenomenon, but also on the relationship between the phenomenon and the environment. The problem for the analyst, the experimenter, and the engineer alike is to construct natural systems within the above three sets of parametric constraints. This can often be only accomplished by manipulating the constraints, *i.e.,* by redefining the phenomenon one is studying, by modifying the purpose of the inquiry, and/or by manipulating the environment of the phenomenon.

Formally, we can define a *natural type* as a type, which satisfies another requirement of a perfect accounting scheme, namely the requirement of collective exhaustiveness. We represent this requirement by equation

$$S_1 + S_2 + S_3 + \ldots + S_n = I , \qquad (2)$$

where S stands for type-constituent variable, the subscripts distinguish between the different variables that collectively define the attribute space within which the type is located as a sub-space, and I stands for the total variance within a well-defined domain of behavior of the occurrences located in the sub-space. 🕮 *382* The natural type is thus constituted by all the variables that are necessary and sufficient to account for the total variance within a well-defined domain of behavior of the occurrences of a given type.

The *ideal type,* on the other hand, is constituted by variables that are necessary, but not sufficient to account for the total variance within a well-defined domain of behavior of the occurrences of a given type. An ideal type does not satisfy equation (2), but satisfies equation

$$S_1 + S_2 + S_3 + \ldots + S_n \geq I , \qquad (12)$$

where all the symbols are interpreted as they were in the just preceding interpretation of equation (2).

It is necessary to briefly comment on some aspects of the above definitions.

First, ‘a well-defined domain of behavior’: Unless we have introduced some such external criterion, every type would be a natural type. The prob-

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[18] It follows that having analytically isolated and formulated a natural system, the experimental and technological task consists only in finding ways of manipulating and measuring the variables of the system, but also of creating, for an experiment a virtually ideal environment *in vitro,* and for a technological operation a virtually ideal environment *in natura.*
This is related to the question of descriptive and normative use of types, which will be explored on the following pages.

lem is, of course, how one defines well a domain of behavior. At first such a definition is likely to be intuitive, then based partly on the variables constituting the ideal types and admitting other variables by analogy, ultimately it will be tautologically defined by the variables that constitute the natural types.[19]

🕮 383

Second, the symbol 'I', or 'total variance (with a well-defined domain of behavior) of occurrences located within the sub-space': Only the variance of those occurrences within the attribute space that are instances of the type needs to be accounted for by the type.

Third, 'accounted for': The interpretation of this term (and strictly speaking of the operators **'+'** in equations (2) and (12) as well) is different for conceptual and for explanatory types. A natural conceptual type *classifies* an occurrence with respect to all the components of variance of such occurrences within the well-defined domain of behavior. An ideal conceptual type classifies the occurrence only with respect to some such components. A natural explanatory type *explains* the variance of occurrences of that type with respect to all the components of their variance within the well-defined domain of behavior. An ideal explanatory type explains the variance of such occurrences only with respect to some such components.

🕮 384

DESCRIPTIVE AND NORMATIVE USE OF TYPES

Clearly, we may prefer, for a particular analytic purpose, to operate with ideal types even if all the components of variance within a well-defined domain of behavior were known to us. One reason for this preference may be *descriptive.* We may wish to conceptualize or to explain the phenomenon within a conceptual or an explanatory scheme, which will relate it to other phenomena, although it will not account for all its variance.

Another reason is that we may wish to use types not only as descriptive, but also as *normative* categories. In such a case, only some of the known components of variance may have normative significance.

An example of the *normative* use of ideal *conceptual* types would be a selection procedure based on this factor-analytic study. For a particular role we may wish to select only those individuals whose scores are above the second standard deviation in the positive sense on Factor A (Idiocratic, Emancipated, Collectivity Oriented Roles of Leadership and Responsibility). We would use membership in this arbitrary ideal conceptual type as the sole criterion of selection, knowing that it accounts only for 36% of the total vari-

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[19] Two examples may suffice. (1) An intuitive definition of each of the domains in this study guided the selection of variables admitted into each domain. After analysis, the factors that were extracted will constitute the ideal types. Other variables that are not reducible to these factors, but intuitively seem in some relevant sense alike, would be admitted into a new domain of the same kind. (2) Weber's explanatory type of bureaucracy is an ideal type within the intuitively defined domain, let us say, of organizational behavior. It explains some, but not all variance in such behavior.

ance in the intuitively defined domain of psychosocial behavior, and that other significant components of variance in that domain are known.

Now an example of the *normative* use of ideal *explanatory* types: Consider the construct “Ejective Channel,” that has been described in Chapter III, as an 🕮 *385* ideal explanatory type. Consider the construct “Total Institution,” as Goffman has described it,[20] as another ideal explanatory type. Consider the social and psychosocial behavior of the staff and the students of a given residential college as the domain of behavior. Let us assume that 15% of the total variance in psychosocial and social behavior in the given college is explainable by the explanatory type “Ejective Channel,” 60% by the explanatory type “Total Institution,” and 25% is unexplained. For a humanist the ideal explanatory type “Total Institution” may become the normative category, and he may wish to reduce the amount of variance in behavior explainable by it, even if he does it by increasing the amount of unexplained variance. The aim of a disciplinarian would be to reduce the unexplained variance and increase the variance explained by “Total Institution.” An educator would make it his goal to increase the amount of variance explained by the type “Ejective Channel.”

The normative use of the ideal explanatory type “Bureaucracy” in the domain of organizational behavior would be another obvious example.

In engineering, the extent to which an ideal explanatory type, e.g., the Carnot heat cycle, explains the variance within a well-defined domain of behavior of a machine, is used as an index of the efficiency of the machine.

🕮 *386*

TYPOLOGICAL ASPECTS OF THE EMPIRICAL RESULTS AND OF THE FRAME OF REFERENCE

The factor-analytic extraction of orthogonal components of variance from conceptually defined domains of behavior enables us to formulate many aspects of our findings in terms of conceptual and explanatory types. Although this conceptual and explanatory formulation is the topic of Chapters IX and X, some of the general characteristics of the findings and of the frame of reference, which are formally related to the use of types as accounting categories, will be briefly described now, in the context of the methodological evaluation of the findings and of the frame of reference.

THE BIAS OF THE PSYCHOLOGISTS

The large amount of variance accounted for by Factor A in the domains of ratings by psychologists was previously explained as partly due to a *bias of the psychologists.* We can now state our hypothesis as to the effect of the bias more precisely: The high amount of variance accounted for by Factor A is due:

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20 GOFFMAN, E. (1957), *Op. cit.*

1. to the increased capacity of the psychologists to discriminate between subjects with respect to a single-component ideal conceptual type, which had for them a normative, as well as a descriptive significance; and
2. to their tendency to dichotomize the type-constituent variable into two extreme types separated by a neutral zone, assigning cases preferably to either of the extreme types.

🕮 387

DEFINITION OF DOMAINS OF BEHAVIOR

We have stated that the decision as to whether a type is natural or ideal is performed against the criterion of a 'well-defined domain of behavior.' We have also stated, that initially such a definition is intuitive. The function of some elements of our conceptual scheme is to provide such a definition of domains of behavior. We have defined, conceptually, several such domains.[21] The general definition of relevant behavior is provided by the conceptual formulation of the psychosocial system. We have distinguished between two general classes of behavior of the psychosocial system that are relevant, namely process and development. The general domain of psychosocial behavior we divided analytically into three domains, of Need Dispositions (or Motivational Orientations), Value Orientations, and Role Orientations. On the basis of these conceptual definitions, we defined the domains operationally, by intuitively evaluating different variables as belonging or not into any given domain. The naturalness of any type will be evaluated in terms of the amount of variance of variables in a given domain that it accounts for.

THE TYPOLOGICAL FINDINGS

The results of the study provide a basis for the classification of subjects in terms of a three-component ideal conceptual type. This type is relevant *🕮 388* in each of the three domains, and accounts, on the average, for 59% of the total variance represented in the domain of psychosocial behavior, as we have conceptually and operationally defined it. A fourth component was interpreted in one of the domains, and a four-component ideal type in that domain (of Need Dispositions) accounts for 72% of the total variance of behavior represented in that domain.

ARBITRARINESS OF TYPES

We have only carried the analysis of the data to the point where any distinctions between types based on the extracted factors as type-constituting variables would have to be arbitrary. To arrive at a non-arbitrary typology (by the first of the two techniques discussed), a study of the distribution of cases within the attribute space would be necessary. Because of the small number of cases on which this study was based, it was felt that the results of such

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21 Chapter II, section on "The Psychosocial System."

procedures would be unreliable. However, we have reached at least a point where we can clearly understand the methodology of non-arbitrary types.

INDUCTIVELY DERIVED EXPLANATORY TYPES

The genotypic interpretation of several of the factors provided some insight into the relationships between phenotypes and genotypes on one hand, and conceptual and explanatory types on the other hand. This insight was formally stated on the preceding pages, and will be utilized in the genotypic formulation 📖 *389* of findings in Chapter X. No explanatory types have been inductively established by the analysis, at the point to which it has been carried. The study has been deliberately directed to the discovery of the coordinates of a psychosocial attribute space, rather than to the isolation of clusters of individuals who share special relations between psychosocial variables. But again, the methodology of the next step has become clear. The study of the relations between variables, conducted separately for members of the different non-arbitrary conceptual types would be the logical next step toward the discovery of explanatory types.

TYPES OF CHANGE

Among the various categories of change, formulated earlier[22] as a part of our conceptual scheme, the following categories are explanatory types:

(a) change: *endogenetic, exogenetic, epigenetic, random (unexplained residual);*

(b) change: *process, development;*

(c) process: *stable, elastic;*

(d) development: *metastable, unstable;*

(e) process: *nomologic, nomothetic, nomographic;*

(f) development: *idiologic, idiothetic, idiographic..*

📖 *390*

STAGES AS TYPES

The construct "stage of development," shown earlier[23] to be a necessary construct for the genetic mode of explanation, corresponds to a conceptual and/or explanatory type. Indeed, the genetic mode of explanation necessary for the analysis of psychosocial development appears to be the only among the various modes of explanation for which the use of types appears indispensable.

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22 Chapter II, section on "Concepts for the Study of Change."

23 Chapter III, section on "The Nature of Genetic Explanation".

Environment as type in epigenetic explanation

The epigenetic mode of explanation[24] formulates psychosocial development as determined by the interaction of two systems: the psychosocial system, and its environment.[25] In the genotypic formulation, any explanatory type that is constituted only by the variables of the psychosocial system will not be able to give a determinate explanation of the relationship between the psychosocial variables. It will at most be able to state constraints. Such an explanatory type will at most have the structure of a partial order (e.g., the structure of a lattice, with least upper bounds and highest lower bounds).

For a determinate explanation of development, we must combine the ideal explanatory psychosocial type with an ideal explanatory type of the environment. This explanatory type of the environment must itself be partially structured.

📖 *391*

Thus we require, for epigenetic explanation, a new conception of 'ideal environment.' It is no longer the trivial case of ideal environment in the deterministic explanation (*i.e.,* a set of null-functions), but a system of part- or full-functions.

The construct "Ejective Channel"[26] is an attempt to formulate such an ideal explanatory type (*i.e.,* an ideal social environment).

📖 *392*

SUMMARY AND PROSPECT

In this chapter we have presented a methodological evaluation of our findings, procedures, and accounting scheme. Types have been defined as accounting categories and discussed with reference both to our findings and our frame of reference.

In the two final chapters we shall present a phenotypic and a genotypic formulation of the empirical findings of this study. The empirical results will be condensed by the use of types as accounting categories. Since the formulation of the results will draw on the conceptual and explanatory categories developed prior to the analysis and presented earlier as our frame of reference, it will also constitute a test of adequacy of the accounting, conceptual, and explanation schemes that we have constructed for the analysis of psychosocial development.

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[24] Chapter III, section on "The Nature of Epigenetic Explanation".

[25] Most theories of psycho-social development further divide the environment into two systems, the (internal) physiological and the (external) social environment.

[26] Chapter III, section on "Ejective Channels: An Explanatory Construct".