a new diagnostic scheme for disorders of behavior, emotion, and learning based on organism-environment interaction

part II. clinical implementation and research*

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In part I of this paper (see p. 218 of this issue), a scheme was proposed for a dimensional analysis of the variables underlying psychopathological and learning disorders. Two types of nervous system handicap—aporia and diaphoria—and two loci of impairment—nonspecific and specific functions—were postulated to interact with environmental factors—ecopathy—in the genesis of pathology. Ecopathic factors alone were seen as capable of generating outcomes equivalent to those that follow nervous system handicap, although such conditions were generally thought to be more amenable to change.

The present paper has two purposes: first, to present methods for implementing the scheme in diagnosis and treatment with currently available clinical and laboratory technology, and second, to consider research problems and strategy to test, refine, and further develop the scheme.

Clinical Implementation

Diagnosis

Information is required about current and developmental ecology and about specific and nonspecific information-processing skills and their history. Sources of information are the 1) family interview, 2) individual and family history, 3) psychological testing or systematic mental status exam, and 4) electroencephalogram (EEG). Experience and expertise permit, and circumstances sometimes require, shortcuts. However, in training programs, research, and early exploration of the method, all four types of data should be obtained. Data are evaluated by a clinician-judge who determines the extent to which the evidence implicates the variables specified by the scheme.

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Three terms are coined in an effort to get away from surplus meanings that characterize potentially suitable available terminology. "Aporia" derives from the Greek root that designates way or means and is meant to convey the idea of lack of means or ability. The adjective would be aporetic. An available synonym is deficit. "Diaphoria" derives from the Greek root that designates to carry or bear. With the prefix "dia," the term designates a movement without specified direction—out of place. The adjective would be diaphoric. Available synonyms are dyscontrol and lability. A third term is "ecopathy" (adjective—ecopathic), which designates pathology-inducing environmental factors. The writer is indebted to Dr. Robert L. Wind of the Emory University Classics Department for suggesting these terms.
Family Interview

One or two family interviews, especially if carried out in the home, should reveal to the trained observer much information about ecopathy under the control of the family. Such assessment is particularly useful in evaluating children. With adults, interviews with at least the other adult members of the family present would be needed. It should be possible, by these means, to determine both the pattern of familial interaction and its relationship to the presenting problem and the history of nonfamilial ecopathic stress—for example, periods of unemployment because of general economic depression.

It must be emphasized that these kinds of data are as important for what they rule out as what they rule in. The psychotic child whose family is neither psychotic, disorganized, nor exploitative draws closer attention to nonecopathic etiology, as does the compulsive child whose family is not rigid or punitive. Also an evaluation based on direct interaction with the family removes at least some of the provocation to blame the family for a particular disorder, a hazard of rampant environmentalism (Kysar 1968). Even if exploitative interactions are found, the problem is formulated as one of intergenerational relationships and family structure, and the clinical intervention produces no scapegoats of its own (Ackerman 1954). Such an evaluation particularly illuminates those disorders, largely constitutional in origin, that lack the dynamics of exploitation but are brought to serious significance by misunderstanding and misevaluation. For example, a high-strung, reactive child, reared by sedate and conservative parents, might be in perpetual conflict simply because the parents do not readily understand or are unduly threatened by the child’s temperamental characteristics. Adequate diagnosis and expert restructuring of parental views may constitute effective treatment (Thomas, Chess, and Birch 1968).

History

A history is obtained from the designated patient, together with other members of the family, but also separately, as necessary, and from available records. The information sought is about the developmental course, possible evidence of aporia and diaphoria, and prior ecopathic factors. In general, aporia is suggested by developmental milestone retardation, by learning problems at school, by impoverished social and sexual relationships, by limited occupational talent, and by poor work history. In general, diaphoria is suggested by a stormy life course, by difficulty in holding relationships, and by impulsive or violent behavior. Care must be taken in coming to such conclusions since coping methods may alter and, at times, radically transform the behavior pattern.

Attention is paid to shifts in the developmental course and the circumstances surrounding the outbreak of symptoms. Is the time of the shift contiguous with developmental milestones that challenge nervous system equipment such as entry to school or onset of puberty, ecopathic events such as a major loss or a traumatic experience, or physical injury (e.g., concussion), or disease (e.g., encephalitis) that may produce aporia, diaphoria, or both? Can the structure of the individual’s relationships account for the disorder?

Contiguous events may reflect a causal relationship, but this relationship should not be assumed. Confidence in such an inference is increased if the link between provocation and consequence is theoretically plausible and if lines of evidence converge. The problem arises because historical reports are subject to distortion and many causal factors are neither apparent nor understood, but some formulation is offered nonetheless. A clinical example may clarify the point. The transition from school-pupil status to adult independence may be stressful but is managed by competent people with relatively little difficulty. A formulation explaining that the college-graduate daughter of a professional family spontaneously decompensated to a severe schizophrenia because of the stress of looking for her first job is intrinsically implausible. Upon investigation, “college” proved to be a key-punching school, negotiated unsuccessfully, after a lifetime of poor school achievement that was misunderstood and overlooked. The actual situation was a pattern of chronic aporia and ecopathic misevaluation that made breakdown on the brink of independence not at all implausible.

Psychological Testing or Mental Status Examination

A standardized test of intelligence or comparable procedure and the satellite devices commonly used in clinical assessment, such as the Bender Gestalt and Human Figure Drawing Test, provide poor approximations of the data required by the scheme. Specific and nonspecific functions are not differentiated; there are no
formal measures of variability; and there is no assessment of nonverbal auditory functions or of any somatosensory functions other than a few visual-motor procedures (Freides 1972). Nonetheless, the information obtained by means of such procedures is of considerable utility.

Verbal and performance scales provide a rough index of specific, auditory, and visual information processing, albeit the performance scales probably confound specific visual functions with the nonspecific and with motor functions. Because the tests were not designed for this purpose, a large element of clinical expertise is required to interpret any particular finding, but a significant negative discrepancy from average levels ordinarily should be a valid index of aporia, especially if the findings are confirmed in a battery of tests.

The major exception occurs if low scores are due to an inconsistent level of performance, with flashes of higher skill accompanied by failure at easier levels. Such variability, known as “scatter” in psychometric parlance (Schafer 1948), is suggestive of diaphoria. Here, the exception is variability associated with attention problems due to habituation handicaps, nonspecific aporias. Other signs of diaphoria are confusion and difficulty in maintaining set or direction in thought and intrusion of primary-process, primitive ideation into contexts where such content is irrelevant (Schafer 1948). Such variables can be assessed by examining the protocols of projective tests or a sample of just about any purposeful communica-
tion or behavior (Chapman 1966 and McGhie 1969). Ambiguous situations, where subjects must provide structure and organization for their ideas and behavior, may be especially revealing of subtle diaphoric conditions.

Available techniques for the formal assessment of capabilities should be supplemented, especially in children, with less widely used but nonetheless standardized procedures that evaluate postural and righting reflexes (Ayres 1972 and Fiorentino 1963), somatosensory functions (Ayres 1972), oculomotor functions, and vestibular functions. The latter two variables require special equipment and will be mentioned again below, but any competent observer can be trained to screen for a jerky visual following response or the absence of nystagmus after rotation.

Mention should be made of the battery of tests employed in the pioneering work on neuropsychological assessment by Halstead (1947) and Reitan (1967). The predictive power of these batteries is based on empirical correlations between the test data and neurosurgical findings—a significant achievement. Most available data, however, have been obtained from previously normal individuals who have sustained brain disorders late in life. Impairment present at birth that might influence development has not until lately been much in focus; nor has there been much concern with diaphoric disturbances or nonspecific functions. Nonetheless, use of the Halstead-Reitan battery in the study of psychopathological conditions has the promise of contributing data that can be compared with data obtained from those persons with known organic impairments. A lack of systematic theory regarding the choice of tests makes it difficult to determine expectations in patients with psychopathology, but the test battery does contain a number of somatosensory, motor, and attentional tasks rare among the standard tools of clinical assessment.

It is of interest that these rare tests differentiated psychopathological and normal subjects in a study (Small et al. 1972) that otherwise found few neuropsychological impairments in the clinical cases. The authors concluded that there were few neuropsychological findings among psychopathological subjects, a result that is in conflict with the thrust of the present proposal. Of course, the design of that study did not take into account considerations raised by the present scheme. For example, although a large proportion of their subjects suffered from depression, the tests were not on the nonspecific functions likely to be impaired in depression but were mostly on the specific functions likely to be spared (Friedman 1964). What positive findings were obtained were with tests that appear to tap nonspecific functions, thus providing support for further neuropsychological study of psychopathology.

**Electroencephalogram**

EEG findings range on a continuum from absence of any abnormality to definite evidence of ictal discharge or abnormal slowing. There is fair agreement as to the meaning of findings that are at the extremes, but the meaning of the middle range of possible results is very debatable. Nevertheless, spike discharges, lateral asymmetries, dysrhythmias, slow wave complexes in the waking state, and unusual distributions of frequencies show correlations with various kinds of adaptational difficulty (Itil, Rizzo, and Shapiro 1967, Kennard, Pollack, and Klein 1966, Ritvo et al. 1970, and Small 1964). In general, spiking and eruptive discharges suggest
diaphoria, and slowing suggests aporia, though this formulation is very tentative.

That the EEG may contribute to the diagnostic process should not be construed to mean that the most definitive evidence for either diaphoria or aporia comes from this source, even if the evidence is unequivocal. To the contrary, there is evidence (Mirsky and Van Buren 1965), for example, that precise measures of behavior are more sensitive than the EEG even to ictal phenomena. The EEG takes its place as one means of assessment, a source of potentially convergent or divergent evidence for the clinician to consider.

A static and routinized approach often contributes little to the definition of problems; yet only slight variations from the routine may uncover otherwise unavailable information. For example, the initial EEG examination may stimulate a heightened state of fear and arousal that can mask a pathological condition; with repeated examinations, situational fear will diminish. A sleep recording often yields findings not seen in the waking state. Finally, some subjects with episodic changes must be evaluated repeatedly at different points in the cycle of their pattern of reaction, and arrangements have to be made to conduct the examination at the appropriate time.

Integration of Findings

The data are examined for evidence regarding each of the dimensions of the nosological scheme. Have ecopathic events or relationships occurred? Are the reaction patterns associated with these events quantitatively and qualitatively commensurate with the experience? Is there evidence for aporia or diaphoria, and is the disturbance in specific or nonspecific functions or both? Which information-processing systems are affected? To what extent do the individual and the people important in his life understand and accept any handicaps he may possess, and to what extent is he misunderstood? Can the findings be arranged in a hierarchy of causal significance?

Ecopathic abnormality is inferred whenever a pattern of behavior that could be plausibly associated with tissue defect is present and environmental antecedents are absent. This situation seems often to be the case in childhood psychosis. The presence of ecopathic factors, of course, does not preclude simultaneous tissue defect, but then the parameters of such conditions are not easily clarified until the environment is altered and adaptation to it evaluated. Admission to a special school, hospital, or other facility with known ecological characteristics and observation for an extended time period may be necessary to obtain relevant data.

Treatment

Diagnosis implies treatment. The logic of the proposed nosology is that the earlier the initiation of treatment, the more likely will it be effective since less stress and failure will have been experienced and fewer maladaptive coping strategies and negative identity components will have developed. There is no assumption such as that found in some psychoanalytic writing that the most definitive treatment must await maturation and independence. One measure of treatment success is the alleviation of symptoms, and direct treatment can be an effective clinical stratagem. Symptoms are not a critical issue, however. The significant issues are the accurate definition and amelioration of the handicaps that are present, change in ecopathic relationships and circumstances, and the undoing of the residual effects of ancient ecopathic events or relationships.

Ecopathic conditions and ecopathic features of disorder are attacked directly whenever possible. Family systems that stultify, scapegoat, and exploit their members should be treated as systems with the techniques developed for such purposes (Haley 1971 and Howells 1971). Misunderstandings that complicate aporetic and diaphoric conditions are rectified by determining the source of misunderstanding, clarifying and reformulating the nature of the problem, and facilitating the social system's assimilation of the handicaps that are present, change in ecopathic relationships and circumstances, and the undoing of the residual effects of ancient ecopathic events or relationships.

Occasionally, the only recourse is to substitute a more benign environment for a noxious one.

When ecopathic conditions cannot be attacked directly because they no longer exist except as memory or are otherwise inaccessible, surrogate evocation of ecopathic events and relationships is provoked by means such as transference in psychoanalytic psychotherapy, role playing and reenactment in psychodrama, and making the rounds in Gestalt therapy (Fagan and Shepherd 1971, p. 145)—procedures that vivify and bring to the present old painful relationships and their residues. Such evocations of the past in the immediate present, in the
context of a supportive relationship with the therapist, make possible the occurrences that are the proximal goals of psychotherapy. These goals vary from case to case, but may include emotional resignification, mourning, learning ideas where they were missing, experiencing feelings when ideas have been isolated, reevaluating, and reconceptualizing the self. The interpersonal skills required of the therapist to create such vivid surrogate experiences and to mobilize the courage to attempt to change—acceptance, empathy, understanding, and technical intervention skill—play a role in every aspect of treatment for every type of problem including those in which ecopathic factors are minimal.

The subtractive, aporetic conditions are treated by replenishment, if available (amphetamine, possibly, for deficiency of the orienting mechanism—Satterfield et al. 1972; L-dopa in parkinsonism), by prostheses (augmented biofeedback for the control of nonspecific overarousal), by compensatory education or reeducation, by individual psychotherapy aimed at the reconceptualization of the self to include a realistic appraisal of handicap, and by family therapy aimed at helping the family to absorb and understand both the nature of the handicap and the conditions under which remediation is most likely to occur. The pattern and format of the treatment process parallels that in the field of rehabilitation of the handicapped, special education, and other areas of professional activity leading to more effective functioning in the face of disability.

Several types of professional skill may be needed in the rehabilitation of particular cases. Speech therapy, physical therapy, and visual orthoptic training, for example, may be ingredients in the rehabilitation package prescribed for a psychopathological condition. However, the professionals involved may have to redefine and reconceptualize their professional roles and viewpoints somewhat in order to be effective. For example, specialists in physical medicine and occupational and physical therapy, who are quite familiar with the phenomenology of disinhibited postural reflexes in cerebral palsy, may have to adjust their thinking to deal with these phenomena as they appear in childhood psychosis. When psychotic behavior is present, there has been a tendency to interpret discernible handicaps either as a derivative of "emotional disorder" or as unrelated to the psychopathology. Such a view would often lead to initiating psychotherapy either with the anticipation that the clarification of internal emotional dynamics would alleviate the handicap or with the idea that the handicap was a secondary issue to be dealt with after the "emotional" disorder was resolved. A different orientation is taken in the proposed scheme. Treatment of a handicap, if present, is central. Emotional disorder will either take care of itself or require psychotherapy only as an adjunct.

The social and psychotherapeutic features of the treatment of aporia are applicable to diaphoria. However, the details of the direct attack on the disorder differ. In aporia, the goal is for the patient to replace, compensate for, or accept the limitation. In diaphoria, it is to isolate, insulate, or withdraw the patient from provocation as well as accept the limitation. Pharmacologic aspects of treatment are chosen from the anticonvulsant and antidepressant drugs. The diaphoric is helped to develop orderly habits that facilitate control and minimize distraction and overarousal. Identifying the stimulation that provokes diaphoric reaction is a critical step in learning to cope with the problem.

Treatment strategies based on the proposed nosology include pharmacological agents where rationally indicated, but mention has not been made of tranquilizers and ataractic drugs. The issue is far from settled, but there is no evidence that they cure disorder. These medications are likely to influence some of the symptoms and later consequences of maladaptation rather than the original problems. The natural function of anxiety—to signal danger and unfamiliarity and to set the occasion and provide motivation for the learning and exercise of new responses—is circumvented by these means, potentially at considerable cost to the personality. Atractics would be used, therefore, only as a means of temporarily ameliorating overwhelming distress or, not insignificantly, as a last resort. Of course, here too, available data suffer from the failings of classical nosology, and there may be particular disorders for which ataractic drugs are the rational treatment.

One additional idea about treatment in the light of the proposed nosology might be added. For individuals who have a history of competent coping, there is a traditional remedy that works very well but is often overlooked—the retreat. An opportunity to remove oneself from sources of stress, to rest and experience a different life pace, may be as effective in some conditions as any form of therapy. Vacations sometimes accomplish these ends. A retreat is the first stage of the treatment of any problem that involves overload or
being out of control, although protection and tranquilization may be additional necessary ingredients under such circumstances.

Some Research Implications

Clinical Validation

Testing the validity of the scheme and its refinement are matters for research. Subjects can be classified as described above and the reliability of those judgments can be ascertained. The reliability and discriminability of the suggested subdivisions (Freides 1976) of each of the major dimensions can be evaluated and the lists then lengthened or shortened accordingly. Studies comparing subjects who show findings in only one of the eight major classifications of the scheme (see figure 1 of Freides 1976—p. 221) could illuminate many issues. It is not necessary that representatives of all eight conditions be found; in some clinical populations all may not, in fact, exist, but groups representing at least two among the aporetic, diaphoric, and ecopathic conditions are needed and three are preferred. In an ideally executed study, groups would share similar symptoms (e.g., schizophrenic diagnoses) and would be equated on actuarial variables such as sex, age, education, social class, duration of symptoms, and family intactness. They could then be compared on other variables with blind testing. In treatment studies, a portion of randomly selected subjects from each group should receive no systematic treatment to provide a control for spontaneous fluctuation and remission.

With such preparation and research design, the treatment implications of the scheme can be evaluated. For example, anticonvulsant medications have had sporadic success with various psychopathologies (Jonas 1965 and Turner 1968). In the present scheme, they should be relevant only to diaphoric disturbances. Similarly, family therapy and other forms of psychotherapy have been claimed to have wide utility but, according to the present proposal, should have the greatest impact on ecopathic conditions. Other studies could be conducted on available retrospective data if such information had not been used for the original classification. For example, birth records might be examined for differential incidence of complications, and school records for evidence of academic achievement or conduct disturbance.

Groups of preclassified subjects can also be compared on a number of procedures heretofore used primarily in research that yields data directly germane to the scheme. If they prove discriminating, these procedures could be introduced into clinical work for use in subsequent diagnosis.

The Continuous Performance Test (CPT) (Rosvold et al. 1956), which minimizes information-processing load but evaluates vigilance, may be useful in assessing diaphoria. Most work with this technique has been devoted to frank seizure states, but recent findings are suggestive of its utility in the study of psychopathology. Orzack and Kornetsky (1971) have shown that among adult chronic schizophrenics, those with disrupted vigilance (diaphoria) were also likely to have a familial history of mental illness and longer periods on medication. This is consistent with the finding of Mednick and Schulsinger (1970) that the behavioral features shared by schizophrenic parents and their offspring are lability and unpredictability (diaphoria).

The habituation of the skin conductance response may be a suitable measure of some of the nonspecific functions that underlie attention, deviations indicating aporias of excitatory or inhibitory components depending on direction. These expectations are based on recent findings (Cohen and Douglas 1972, Gruzelier and Venables 1972, and Satterfield et al. 1972) in which pathological subjects either failed to orient; over-oriented, failed to habituate and gave excessive spontaneous responses; or deviated in response parameters such as the recovery limb. Venables (1972), relating these findings to the work of Pribram (1967), suggested that underorientation and overorientation may be due to impairment of limbic functions—more specifically, excitatory amygdaloid factors or inhibitory hippocampal factors, respectively. If this suggestion is verified, the technique would make possible the localization of subcortical impairment. Since progress in determining the meaning of the skin conductance measure has been hampered by procedural idiosyncracy, standard methods (Lykken and Venables 1972) should be employed in research related to the scheme, or the reasons for deviation should be specified.

Another means of assessing nonspecific aporias of excitatory and inhibitory functions is the area of signal detection and sensory threshold determination. There is evidence that glucocorticoid concentrations affect the threshold of stimulus detection at least in some sensory modalities (Henkin 1970). There is also evidence that
lesions of the hippocampus raise (Knigge 1961), and of the amygdala depress (Mason et al. 1961), steroid output. Thus, low thresholds and extra fast reaction times should reflect inhibitory aporia, and high thresholds and slow reaction times, should reflect excitatory aporia. Behavioral and perceptual findings should parallel psychophysiological conductance measures. Methodologically, signal detection procedures should be employed for sensory measurements to minimize the effects of response biases (Green and Swets 1966). It would also be of interest to compare sensory acuity and reaction time to signals (across and within subjects) in each of the major sensory modalities providing that ambient and focal stimulation were presented in each modality at comparable decibel levels (Kohfeld 1971). Comparison across response systems might also depend on such control.

Nonspecific functions mediated by the vestibuloculomotor-cerebellar axis of the brain appear strongly implicated in psychopathology (Holzman, Proctor, and Hughes 1973, Ornitz 1970, Prescott 1971, and Rosenbaum 1971) and merit research attention within the framework of the scheme. Some expressions of this system have been studied extensively, such as postrotatory and caloric ocular nystagmus (Eviatar and Goodhill 1968a and 1968b) and ocular orienting (tracking) movements (Jung and Kornhuber 1964). Of special interest are studies that compare the response system under conditions of unimodal and multimodal stimulation. There is evidence (Ornitz 1970) that some psychotic children may have diminished postrotational nystagmus in the light but a normal response in the dark, suggesting a failure of sensory integration at the nonspecific level. Sophisticated measures of body reflexes (Hellebrandt, Schade, and Carns 1962 and Tokizane et al. 1951-52) have been neglected in psychopathological research but may reveal that handicap is as common on the output as on the input side.

The dimensions of specific functions and complex spatial, temporal, and motoric pattern analysis were discussed in an earlier paper (Freides 1976). Suggestions for the assessment of these functions (Freides 1974) were based on the concept that sensory modalities are specialized for dealing with particular kinds of information. Since information arriving at nonadept modalities is translated to that of the more adept modality before processing, comprehensive assessment would require evaluation of each major category of information processing in each modality so that both primary adeptness and translation skill can be determined. In addition, verbal skills and conceptual ability could be evaluated. With theoretical developments in the psychology of intelligence and cognition such as that stimulated by Piaget, a theoretically integrated approach to the evaluation of "higher" specific functions (Luria 1966) can augment the paper-and-pencil procedures validated by school achievement that now prevail (e.g., Guilford 1967).

EEG findings in the various diagnostic groups also merit further exploration, particularly the hypothesis that eruptive discharges are associated with diaphoria and slowing with aporia. Study of a variety of activation techniques, pharmacological (Monroe 1970) as well as psychological (Small, Stevens, and Milstein 1964), and somewhat different measurement operations, such as electrode placement in the nasal mucosa or telemetric techniques that permit free movement, might more reliably reveal abnormalities present in the brain than existing standard procedures without resorting to intracranial electrodes (Brazier 1968).

Broader Implications

Diaphoria

In the behavioral sciences, concepts about the sources of variability found with any measurement tend to emphasize either the oscillation inherent in biological systems (a kind of unavoidable imprecision not tolerated in mechanical devices) or the error of the measuring procedure. Both are appropriate for considering aporia or the competent functions that are its converse, but such concepts are not relevant to diaphoria. It is generally not recognized that variation in consistency across the entire population, in the normal as well as pathological range, is a dimension that merits evaluation. Accordingly, an additional approach to the measurement of variability is needed.

To study or control for diaphoria, provision must be made for the evaluation of intrasubject variability or consistency. The best method for accomplishing this evaluation is not known, but the problem might be approached from several directions. One might examine subject variability distributions associated with the several determinations usually required to obtain a single measure of competence. Another would assess intrasubject variability associated with repeated measures of the same function at different times. A different approach
would vary input parameters systematically (e.g., the detectability of a signal) and determine the consistency, within subjects, with which input changes are reflected in output measures. Yet another strategy would, like the CPT, minimize information-processing load and assess response consistency.

With indices of intrasubject variability available, acuity or competence measures can be examined in relation to the distribution of variabilities. The procedure would depend on the shapes of the distributions that emerged, but it might be useful to compare competence measures within a specified range of intrasubject variability. On logical grounds, it can be anticipated that highest intrasubject variability would be associated with somewhat lowered but nondeficient levels of competence, while low intrasubject variability would include all levels of performance. Intermediate levels of variability would also be associated with a wide range of competencies, and the interaction here may be of considerable general interest since there may be optional trade-off between consistency and accuracy.

**Equipment versus Experience**

An assessment strategy for differentiating the effects of equipment and experience with behavioral measures can be suggested on the basis of pattern of response over time to relevant stimulation. The fundamental assumption is that the nervous system operates so as to minimize uncertainty and maximize reward (though under certain kinds of noxious stress there are exceptions; see Epstein 1972). If a subject has not previously adopted the most efficient strategy of which he is capable, he will learn it, given enough time and incentive.

Differentiation between equipment and experience is based on the hypothesis that if experience is equivalent, differences in competency level (speed, skill, acuity, cognition) are due to equipment differences. Barring ceiling effects, experience would increase the level of functioning. Curves reflecting changes due to experience or learning of individuals with different equipment capability would run in parallel, or the lesser capability would show a relative decline. Difference in level of function due to differences in prior experience would, with relevant stimulation and incentive, produce a learning curve for the less experienced that is steeper in acceleration than that of the more experienced.

Thus equipment deficiency would be defined as a pattern of response parallel to, but lower than, or relatively decelerating in comparison with, that of intact or competent equipment under conditions of relevant stimulation and incentive. Experience deficiency would be defined as an initially lower level of response, which with relevant stimulation and incentive, shows a steeper pattern of acceleration than what is found at an initially higher level of attainment. For a particular function, it is not always known just how much experience is required before there is reasonable assurance that improvement or acceleration will not take place, or what the ceiling may be, or what constitutes relevant stimulation and incentive, but the questions are researchable. It is theoretically possible for an aporia due to experience to produce results identical to equipment limitations in all respects, but it seems likely that this will most often occur through disuse atrophy where structural changes have taken place.

Equipment diaphoria should be discriminable from ecopathic diaphoria by means of tasks that provide incentive for consistency, perhaps with distractions that make consistency difficult. Although both types of diaphoria might improve under such a regime, equipment problems should improve more slowly.

**Intact versus Compensated Function**

Even when equipment is actually deficient, some kinds of assessment may reveal no deficiency. Such an outcome can occur as a result of compensation. Despite equivalence of function, there may be reasons for differentiating between the two conditions.

A possible means of differential assessment is through reaction time measures; compensated reactions, by definition, must take longer. However, compensation can also take place through enhancement of other functions. For example, the blind have extra skill in tactual and acoustic perception, and similar compensations occur when the deficiency is less than absolute (Freides 1974). To evaluate such compensations, several functions must be assessed and their normal interrelationship understood.

**The Parts and the Whole**

The scheme is based on a hierarchically organized model of nervous system information processing—motor...
control operation. At each level of function (non-specific, specific), there are horizontally shared characteristics among the component operations that make up that level. For example, it has been reported that among the nonspecific functions, the parameters of focal and ambient stimulation, apart from sensory modality, determine information-processing outcomes, whereas among specific functions, sensory modality and the property of adeptness are determinative. It is also possible to delineate vertical similarities among particular processes that have the character, as one shifts from more to less specific, of decreasing sophistication and precision—for example, visual spatial pattern discrimination, visual localization, visual receptor orientation, and tonic neck reflexes, all of which have to do with differentiating positions in space. The components, horizontally and vertically, appear to be mediated more or less independently but normally operate jointly with near, or actual, simultaneity.

A suitable sampling of both narrowly constrained functions among the horizontal and vertical continua and of indices of integration and coherence among levels and functions should be evaluated. For the former task, simple and explicit tests would be sought with careful attention to such parameters as stimulation and incentive. A function would be taxed to the utmost under highly specified conditions, thereby revealing its operative characteristics. Such strategy is parallel to that of the basal metabolism or the glucose tolerance test. For the latter task, generalized indices of competence that more nearly reflect everyday demands and levels of activation would be needed. Measures of integrative capability might include segmental set (Shakow 1962), cross-modal functions (Freides 1974), problem solving and concept formation tasks, sensory motor tasks, and broad spectrum devices like tests of intelligence. Such strategy parallels inquiry into general status as revealed by weight and skin tonus and subjective feelings of well-being.

The results of such an array of findings, along with concomitant evaluation of consistency, could then be formed into a diagnostic picture of strengths, compensations, and weaknesses, with specification as to the nub of the problem in the hierarchy of functions. What functions must be assessed and which parameters must be compared for a formulation to be useful can be determined only in the light of experience. Lists of variables that might be used to initiate the effort can be found in the theoretical paper (Freides 1976).

**Personality and Individual Differences**

The present scheme appears to be pertinent to research and theory on normal personality development and individual differences where, in studies of temperament, the concept of impulsivity has been related to data on variability (Barrett 1972) and that of extraversion to excitation-inhibition balance (Eysenck 1967). In theory, temperament has largely to do with constitutional factors, but the starting point in most research has been data obtained from self-report questionnaires that inevitably reflect not only constitutional factors but also coping mechanisms and identity. The present analysis, especially the distinction between diaphoric and non-specific excitation-inhibition balance, might make possible better control over component factors that current measures confound.

Support for the proposed scheme appears to be present in the findings of other work on temperament in which direct observations of behavior (rather than self-report) were used as starting points for analysis. Thomas, Chess, and Birch (1968), studying infants, found such dimensions of temperament as rhythmicity, mood, activity level, threshold, and persistence. The first two examples parallel different aspects of the diaphoric continuum while the other three appear to be expressions of nonspecific excitation-inhibition balance. Such balance is explicitly of concern in research pursuing Pavlov’s ideas about the properties of the nervous system (Teplov 1972). Originally, concepts such as strength and sensitivity of the nervous system were put forward in a manner that suggested that these properties occurred in singular fashion—that is, the property might be expected to recur in each function measured. Nebylitsyn (1972, pp. 400-401), summarizing several studies, found that the correlations across several measures—for example, conditioning rates in different sensory modalities—though positive, were very low. Such findings would be consistent with the assumption of relative independence of nervous system components propounded here. He also pointed out, however, that only 15-25 percent of the subjects were responsible for the low correlations. This evidence is consistent with an orthogonal diaphoric factor, although no construct of this sort seems to have been offered to account for the data. (Periodic schizophrenia, a concept close to diaphoria, is prominent in the Russian literature on psychosis, however; see Mirsky 1969.) If diaphoric individuals were removed from the sample, correlations across modalities for the same
information-processing system might rise, but the parameters of different information-processing systems might still be largely independent. These are empirical questions amenable to investigation.

Another area in which the aporia-diaphoria distinction may prove helpful is in research on anxiety. The convergence of several lines of evidence (Spielberger 1966 and 1972) has led to a shift from the primary view that anxiety is a drive or a concomitant of drives like pain to the view that the emotion is a concomitant of perceptual and cognitive operations. (This parallels the shift in focus from emotion to information processing as an explanatory variable in psychopathology that is presented in the present scheme.) In an incisive review, Epstein (1972) concluded that there are three basic conditions in which anxiety is elicited: 1) primary overstimulation (such as pain), 2) cognitive incongruity (failure of expectation and inability to form a valid predictive model of what is to occur), and 3) response unavailability (helplessness, or the prevention of the execution of coping reactions). Much of the research from which these generalizations emerged involved environmental manipulations (e.g., variations in conditions that influence the ease of formulating valid expectations) and the measurement of individual differences by means of questionnaires. It was suggested earlier in the discussion of temperament that self-report measures inevitably confound several sources of individual differences, and the point is applicable to anxiety scales as well. Saltz (1970), for example, marshaled evidence from the literature on anxiety and verbal learning that anxiety questionnaires were measuring fear of failure in some subjects and fear of pain in others. More anxious subjects (as measured by self-report) performed more effectively under pain stress than less anxious subjects, while less anxious subjects performed more effectively under failure stress.

Such evidence warrants the search for cleaner and more effective measures of individual differences, and the present analysis of constitutional factors may be helpful. Characteristics of information-processing equipment should determine what constitutes overstimulation, incongruity, or response unavailability as much as the situation to which the individual is exposed. A diaphoric individual is more likely to be overstimulated by less stimulation; an aporetic will find himself without responses to relatively easy problems and find such problems to be incongruous. The range of possibilities for anxiety as much as for psychopathology can be assessed only if the organism and the environment are viewed interactively.

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