

Toward a Neuropsychological Theory of Person

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Not so long ago popular discourse employed such phrases as "she has a lovely personality," "he has a rigid personality." Today the mode of expression would more likely be "she is a lovely *person*" and so on. What was once an attributed function is now conceived as intrinsic structure.

My first reaction to this shift in the emphasis of discourse was that it portrayed the common and suspect process of reification of a function. There may be truth to this view. But I feel that in this instance the shift may reflect some deeper awareness.

Personality theory and the very concept of personality stem from the observation and study of inter- and intra-individual differences in attributes which occur among members of a social group. Most naturally the focus of description falls on the group. However, once these differences are established, inquiry turns readily to the identified individual—characteristic personalities become the characters of persons. Only a *person* can have character, an intrinsic structure, and the problem remains to develop methods for the objective analysis of this structure.

In keeping with the shift in emphasis in popular usage, scientific study has also grown through a phase of descriptive functionalism based on a single mode or level of observation. The present concern is beginning to deal multidimensionally with structure—structure conceived not as an invariant "res, a thing" but as the "organization of process" (For example, different characters or, perhaps better, different aspects of character, may be displayed according to circumstance). My interest fits this trend. For one time-honored means of studying organization is to analyze the mechanism which produces that organization. (Indeed, mechanism and structure are often treated as synonymous; but this synonymy falls heir to the problems of the reductionist fallacy). My aim here is to describe the results of recently performed neurophysiological and neuropsychological experiments and to delineate from these two dimensions relevant to the problem of "person."

SOME EXPERIMENTS

The experiments concern the control which an organism's central nervous system exerts over its input. Early observations showed that the configurations of the electrical responses in the input channels evoked by light or sound stimulation were different when an animal attended to the stimulation and when it was distracted (Hernandez-Peon *et al.* 1956a, 1956b). Also, electrical stimulation of efferent tracts (thought to serve motor functions), and even of some brain stem systems, resulted in changes in the amount of neural activity recorded from afferent fibers originating in receptors (Hagbarth and Kerr 1954:295-307).

In my laboratory a series of studies has extended these observations. Auditory and visual receptor mechanisms, for example, are each sensitive to activities occurring in the other (Spinelli *et al.* 1965:303-319; Weingarten and Spinelli 1966:363-376). Control over input can be originated in cortex—especially that cortex usually called “association” (Spinelli *et al.* 1965:303-319; Spinelli and Pribram 1966:44-49). These results are important because they effect a drastically changed view of the functions of not only these cortical areas but of the entire brain itself. Until recently, sensory events were thought to initiate an input to the brain where a variety of such inputs were integrated or associated into more complex configurations. These, in turn, were thought to determine the movements, to regulate the motor apparatus, of the organism. This view was based on several premises: an empiricist, associationistic philosophy; a reflex arc conceptualization of the organization of reflex behavior; the presence of cortico-cortical connections via large tracts of nerve fibers.

I have elsewhere (Pribram 1960:1-40; Miller *et al.* 1960) detailed the evidence which leads to a revision of the reflex arc concept in favor of a servomechanism type of reflex organization. The experiments presented above add substantially to the body of results already established, which show that feedback is ubiquitous in the organization of the nervous system. In view of this fact, any simple stimulus-response, reflex-arc, model of brain-behavior organization—even when embellished by mediational stages—becomes untenable.

The cortico-cortical connections pose a more puzzling problem; their presence is an established fact. However, major connections are *not* from the receiving areas of the brain to the so-called association cortex. Rather, the pattern is that *every* cortical point is connected with its immediate neighbors by short, relatively fine, fibers and with more remote locations by longer and stouter ones. The functions in behavior of these connections are the puzzle: cutting through them by surgical removal of tissue (Chow 1954:762-1771) or by cross-hatching (Sperry *et al.* 1955:50-58; Pribram *et al.* 1966:358-364) has so far resulted in *no* detectible change in behavior.

By contrast, surgical removal (Pribram 1966:324-367) or cutting the input-output connections (Pribram *et al.* 1966:365-1373; Wade 1952:179-207) of the so-called association areas produces profound disturbances in the problem-solving ability of primates.

Further, one of the major divisions of the "association cortex" is divisible into areas, each of which serves one or another sensory mode. Modality specificity of so-called association cortex has been amply documented: in somesthesia (Pribram and Barry 1956:99-106; M. Wilson 1957:630-635); taste (Bagshaw and Pribram 1953:399-408); audition (Weiskrantz and Mishkin 1958:406-414; Dewson, Nobel, and Pribram 1966:151-159); and vision (Blum *et al.* 1950:53-100; Mishkin and Pribram 1954:14-20; Chow 1952:109-118). How can the notion that these areas serve an "associative" function be maintained in the face of this evidence?

Even that division of the association cortex—the frontal—which has been found to be nonspecific with regard to sensory modality (Pribram 1961:311-320) is specific for a particular type of problem-solving ability. Frontal cortex is involved in short-term memory processes (Pribram *et al.* 1964:28-55).

The inescapable suggestion derived from this series of experimental results parallels that derived from those delineating the "servo" nature of neural organization: a simple stimulus-response-association model of brain-behavior organization has become untenable.

However, the demonstration of efferent control of input provides the beginning of a plausible alternative. Instead of ever more complex integrations being effected in brain regions remote from input channels, the data suggest that these remote regions exert their influence downstream at various stations—controlling, programming, and organizing the events directly in the input channels *per se*. The effect obtained is similar to that produced in a computer program by the addition of recursive servolike, hierarchically-arranged loops established as subroutines.

Some facets of the nature of the efferent control have already been clarified. Ordinarily each input channel has a good deal of reserve redundancy in processing the information derived from the input; that is, a particular signal is carried over many parallel fibers. But the experiments mentioned have shown that the activity of the "association" areas of the brain can alter the amount of channel redundancy, the number of fibers used to carry a signal. Electrical stimulation of the cortex reduces redundancy (Spinelli and Pribram 1966:44-49); removal of this cortex has the opposite effect (Dewson *et al.* 1966:123-124). In addition, electrical stimulation of the frontal cortex (the part of the brain involved in short-term memory processes) has been shown to increase redundancy (Spinelli and Pribram 1967:143-149). As yet we have no evidence whether this increase is simply quantitative or whether some structuring of the redundancy is involved. These experiments show that the organism's input is influenced by the

most recently developed portions of the central nervous system, and further, that two reciprocally-acting mechanisms of control exist.

The psychological effect of altering the amount and the structure of redundancy in an information processing system has not been fully explored but a few facts have been ascertained. For example, the greater the redundancy the greater the temporal resolution among input events; on the other hand, reduced redundancy leads to greater sensitivity to the complexities of input (Garner 1962:153, 161, 172, 183, 276). Thus, not only the clarity, but the very range of our perceptions seems to be under the control of this brain mechanism.

Though these findings are important to an understanding of the perceptual process they may be even more critical in molding our view of what is involved in motivation and emotion. This dividend comes in the experimental realization of the fact that organisms can respond to stimulation in ways which are not externalized as behavior. For the past half century behaviorism has pervaded psychology to the point where many tend to forget that an organism has in his repertoire reactions other than those immediately observable in behavior. Properly conceived neurophysiological research is especially potent in uncovering these "internal" reactions. Expectations, intentions, thoughts, and feelings are thus becoming legitimate topics for *objective* inquiry. As an important addition to the tools of behavioral research this neurologically oriented neomentalist approach promises to enrich scientific psychology considerably. Here, let me focus on the relevance of the experiments described to the puzzling relationship between motivation and emotion.

THE EFFECTIVE-AFFECTIVE DIMENSION

According to the experimental results discussed above, one of the possible reactions an organism may have to a situation is to control the input initiated by that situation. Elsewhere, I have suggested (Pribram, 1967) that "e-motion" is manifest when an organism meets a situation by input control rather than through instrumental action. In this view, emotion, or what is now so aptly referred to by today's young as "a hangup," is not conceived to be an haphazard affair. Rather, just as action is motivated, that is, controlled, by the operation of a hierarchy of neural servomechanisms, programs or plans (Miller *et al.* 1960), so passion is e-moted, that is, decontrolled by relinquishing or "pruning" smaller or larger segments or subroutines of these same programs, and restoring and strengthening earlier or simpler versions. As an example, take the interesting descriptions of the turning of the motive "love" into the emotion "in love" through separation as given by Reik (1941).

According to this analysis, then, one dimension along which a person's character may vary is the extent to which interaction with his environment

displays action or passion—is effective or affective. Persons as *actors* effective, normal, and useful in their society have been chiefly considered by social scientists; exploration of the *passions* has been left to clinical psychologists and psychiatrists. Consequently, emotion, affect, has been suspect: we have come to think of it as somehow unhealthy, abnormal, futile. And yet, the error of this view is obvious. Attributes such as strength of character, creativity, and so on are known even by the layman to depend on the nonbehavioral reactions of a person to his situation. The techniques are at hand; there is no longer any good reason to withhold physiological observations from experiments made to investigate these processes, even by social scientists. The objective study of behavior can now be fruitfully complimented by the objective study of such nonbehavioral, internal, "mental" reactions of experimental subjects.

THE ESTHETIC-ETHICAL DIMENSION

For the purposes of this symposium I wish to elaborate more fully a second dimension which can be discerned from this set of neurophysiological and neurobehavioral experiments. This dimension deals with the fact that the brain contains a mechanism by which the amount of redundancy in a system, the amount of synchronous activity, can be governed. In the experiments cited, this regulation was shown to be effective over input, and there is evidence (Brooks and Asanuma 1965:674-681; 1965:247-278) that a similar effect operates on motor systems.

As already noted, the importance to the psychological process of redundancy regulation has as yet been only partially explored. On the input side, redundancy *reduction* is involved when interest and sensory *participation* are called forth: redundancy *enhancement* helps *focus and restrict* the organism's sensory interaction with the situation. The two processes are ordinarily balanced, for they converge on the same input mechanism, even on some of the same cells in the mechanism (Spinielli and Pribram 1967: 143-149). It is likely that the adjustment of this balance differs in different individuals in different situations.

Here, therefore, is an example of another dimension along which individual differences and differences among individuals may be produced from occasion to occasion. Some individuals are more inclined to sensory participation with their environment, and some situations tend to evoke participation more than others. Such evocation is the essence of esthetic endeavor, and for this reason redundancy reduction can be thought of as a mechanism underlying an esthetic mode of reaction. Its opposite, an increase in redundancy, tends to focus and remove the organism from participation and to turn him inward. He is therefore responsive more to his own neural organization than to the organization of his environment. This

mode of reaction is characteristically displayed, for instance, when ethical considerations are involved (as when a person asks whether he is being true to himself).

A convergent line of evidence concerning this dimension comes from observations of behavior. Here, also, two processes are identified and the processes bear a resemblance to those already identified. In a recent study, Schachter (in press) examined the determinants of eating in obese and nonobese persons and showed that the obese person's eating is more under the control of external than of internal determinants, while the opposite is true of the nonobese person. In other words, most people eat when their physiological state demands; the gourmand responds to opportunity.

Another convergence comes from psychophysiological experiment. Lacey (1965:161-208) has used heart rate and other measures of autonomic nervous system reactivity to gauge the receptivity of an organism to stimulation. The evidence is that two modes exist—one "open" and one relatively "closed": "Cardiac deceleration accompanied and perhaps even facilitated ease of 'environmental intake' whereas cardiac acceleration accompanied or facilitated 'rejection of the environment.'" Data are presented to show that cognitive problem solving demanding "internal" work produces cardiac acceleration while situations demanding anticipatory vigilance, an "external orientation," are accompanied by cardiac deceleration. Clearly, an "open-closed" dimension is discernible in these results. It remains to be shown that the convergence with the recovery cycle data is real and not spurious; simultaneous recording of heart rate and evoked recovery functions in the two types of situation is an indicated next step.

The delineation of the esthetic-ethical dimension finds parallels in conceptions derived from still other types of observations. Developmental studies led Piaget to formulate the suggestion that two complementary processes guide cognitive growth. One process he labels *accommodation*; the other, *assimilation*. "In their initial directions, assimilation and accommodation are obviously opposed to one another, since assimilation is conservative and tends to subordinate the environment to the organism as it is, whereas accommodation is the source of changes and bends the organism to the successive constraints of the environment." (Piaget 1954:352) Thus, "the nursling's psychic activity is at first only simple assimilation of the external environment to the functioning of the organs. Through the medium of assimilatory schemata, at first fixed, then mobile, the child proceeds from this elementary assimilation to putting means and ends into relationships such that the assimilation of things to personal activity and the accommodation of schemata to the external environment find an increasingly stable balance. The undifferentiated and chaotic assimilation and accommodation which characterize the first months of life are superseded by assimilation and accommodation simultaneously dissociated and complementary."

(Piaget 1954:219) Accommodation thus resembles the effect which a neurologically-based redundancy reduction mechanism would be expected to exert; assimilation could well be effected by redundancy enhancement.

This convergence of conceptions does not in itself mean that accommodation is necessarily accomplished through redundancy reduction and that assimilation occurs through an increase in the synchronous operation of the organism's input mechanism. However, as hypotheses these possibilities can be fruitfully explored since the parts of the brain responsible for shifts in redundancy are known, as are the effects of removal of these parts on problem solving in adult primates. Thus, removal of the appropriate structure in young animals should have effects predictable from Piaget's formulation.

Other convergences come to mind. Factor analytic methods of studying subjects with brain lesions have been undertaken by Halstead (1947), Reitan (1966), and Teuber's group (Semmes *et al.* 1960). Of particular relevance here is the fact that most factor-analytic studies have yielded some sort of introversion-extroversion dimension. Petrie some years ago (1952) presented in detail carefully controlled evidence that frontal leucotomy leads to changes "on test measurements associated with the dimension of extraversion-introversion." The finding that these changes occur in the direction of greater extraversion is convergent with the model based on recovery-cycle here presented: removal of the influence of frontal lobe tissue leads to redundancy reduction in the input channels and hence "greater sensitivity to the complexities of the input." More recently (1967), Petrie has extended her work by devising a set of behavioral tests with which she has delineated additional ways of characterizing persons: a stimulus augmentor-stimulus reducer dimension and an autonomy-externally controlled dimension. She is at present engaged in a series of studies, using neurosurgical patients, aimed at relating her behavioral observations to their neural substates. Should this current work be combined with some simple neurophysiological observations, for example, elucidating recovery functions as in the experiments described here, another convergence among models could readily be accomplished. On the whole, electrophysiological data taken in conjunction with factor-analytic analysis should prove extremely fruitful. Pioneering studies of this sort have been undertaken. Pawlik and Cattell (1965:129-151) have analysed the organism's readiness to be aroused, and Barratt (1959a:63-66; 1959b:191-198) has investigated Lacey and Lacey's (1958:144-209) stabile-labile dimension of readiness to react.

Considerably more remote would be studies which relate the neurologically derived models with those based on social-cultural observation. Nonetheless, I believe such studies are possible. For example, Riesman (1955) has, from social-historical observation, delineated what he calls

"inner-directed" and "other-directed" individuals. It could be that developmental exigencies mold some individuals along primarily redundancy-reducing, accommodative modes of communicative intercourse. And it could be that other circumstances yield primarily redundancy-enhancing, assimilative modes of communicative discourse. In this way a person (or even a whole population) would become primarily esthetic or primarily ethical in interpersonal interactions, depending on the formative culture.

Many questions can be raised within the framework of these observations: for instance, is inner- and other-direction synonymous with introversion and extroversion? Are there indeed more gourmands in other-directed societies, as the Schächter experiments might suggest, or is the relationship between inner- and other-direction specific to a reaction mode? Can the balance between esthetic and ethical sensitivity be altered by later experience or is there a limited "critical" period during development which "sets" the organism on one or another course? Do society and its culture determine not only the balance between the esthetic and ethical mode but also the emotional consequences of each reaction? In another paper, Melges and I (in press) tentatively proposed a classification of affects based in part on the difference between an ethical mode of reaction, which we called preparatory (or better, prereparatory) and an esthetic mode which we called participatory. The suggestion was made that the affect associated with the ethical, preparatory type of reaction is, as a rule, pessimistic, whereas esthetic participation begets optimism. This suggestion was based on current clinical experience and attributed to the fact that the social outcome of participation was, on the basis of experience, appraised by an organism as potentially successful in establishing or reestablishing control, whereas preparatory maneuvers could, on the basis of experience, be expected to pose difficulties. However, this view is surely culture bound: participatory reactions are rewarded in a society populated by persons holding the Freudian point of view, but the preparatory mode is the more effective in a society subscribing to the Protestant ethic (Rieff 1959). In fact, those of an older generation often find the cocktail party the epitome of a demand for an almost exclusively participatory mode of intercourse—and hence a most trying experience accompanied by anxiety produced by the enhanced internal uncertainty and reduced redundancy necessary to be simultaneously open to a large number of information sources. For this earlier generation, the ethical mode of living true to one's principles proved a gratifying experience and thus led, in them, to optimistic affects.

In summary, then, two dimensions of "person" have been delineated from one set of neurobehavioral and neurophysiological results. I have here explored, for one of these dimensions, some possible convergences with other conceptions derived from other data and have suggested experiments and applications that come to mind as a result of the exploration. I have dwelled on convergences. An alternative would have been to spell out a

more inclusive set of dimensions; I have eschewed this alternative—partly because I feel it would be premature to espouse it. But there is another reason for my choice. So much of scientific endeavor today is concerned with checking the reliability of conceptions by logical and experimental analytic procedure. Too often the validity of the conceptions remains either unquestioned or is dismissed by ridicule—as when a model is maligned as “reductive” or its converse, “soft.” I urge that the validity of many conceptual systems can be tested by attention to convergences among them and by testing these convergences by performing experiments and observations in situations or contexts that combine elements from those which led to the original formulations. Without such synthesis through cross-disciplinary effort, science is likely to culminate in a tower of Babel where the many, by referring to the same event structured in different realms of discourse, fail totally to communicate.

Specific to our present concern is the fact that societies are made up of persons whose *brains* shape the interactive matrix. There should therefore be no barrier in using data from social observation, personality analysis and neurological experiment to come to a common understanding. In the spirit of this kind of cross-disciplinary endeavor, starting with a set of experimental results accomplished in my laboratories, I have described several areas where the investigation of “person” has led to an apparent convergence of concepts, a convergence which persuades follow-through: one such area would explore an effective-affective dimension, the other an esthetic-ethical dimension, along which persons may vary.

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