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Chapter VI

Un-defining Mind and Culture

> "The conception of human nature is fundamentally a conception of the human biological organism as uniquely adapted for acquiring complex and elaborate habits (where habit is understood as a pattern of behavior which is learned, but which is nevertheless largely present below the level of conscious attention when it is enacted).
>
> The conception of mind sees it as an aspect of some of these acquired habits, related to their public and conscious coordination and control. Mind is not one homogeneous entity separated from physiological function, but an evolved aspect of physiological function, related especially to communication, that provides a series of more or less separate and often unrelated "handles" on different kinds of activities and functions." [Leaf 79: 334]

Leaf provides a good general summary of the hermeneutic or interpretivist conception of mind: an outgrowth of biology, focused on communication, and deeply related to its social (and physiological) context. The alternative model proposed in the last chapter is grounded in biology and is, in fact, an attempt to directly model a bio-physiological processor - the human brain. Communication is a diffuse problem with aspects discussed throughout this discussion; that leaves "context" as the central issue for this chapter. Defining mind in terms of context, delineating the relationship between structure and context, defining the extents and parameters of context, elucidating the mechanisms of "contextualizing," etc. Although several aspects of context will be noted in passing, the focus of the discussion will be on that particular form of context labelled "culture."

Three significant, inter-related and oft encountered obstacles to an adequate treatment of the "context problem" include:

1) Processing limitations. There is abundant evidence that the human mind and the human brain are significantly limited in their ability to consciously1 process information. An example of a limitation on the conscious mind is Miller's number - seven plus or minus two - limiting the number of "concepts" that can be present in mind at any one time. [Miller 48] An example of physiological limitations is the "raw processing speed" of the brain (in

1 The qualifier "consciously" is important to remember here. In terms of its parallel capacity the brain has immense processing capability and obviously has the ability to handle a multitude of complex simultaneous tasks. If it did not have this ability the organism itself would cease to function.

terms of its neural transmission time) which limits the number of discrete processing steps possible between receiving a stimulus and sending a response. [Conrad 87]

It is equally well known that a majority of the stimuli received by the brain from the environment is "ignored" by the conscious mind. A common example is provided by the multitude of sounds in a home. Although ever present, they seem to enter our awareness only in times of alert - like when it is late at night and we are alone in a dark house.

Any adequate model of mind needs to address the processing limitations issue, but this need is amplified for hermeneutic models that mandate the inclusion of massive amounts of context in cognitive processing.

2) Organization. The sheer complexity of the cognitive environment seems to demand some sort of organization scheme be applied to that environment to make it tractable to processing. Such a scheme lies at the heart of every formalist model in the guise of knowledge representation techniques. Hermeneutic models (as proposed here) will eschew formal knowledge representation issues but must nevertheless address the organization problem.

3) Learning. Problems caused by the complexity of the cognitive environment are exacerbated by its volume. To the extent that we are dealing with culture, it is generally

agreed that our cognitive abilities are learned. Given the constant, always varying, and immensely complex set of stimuli that make up the cognitive context, how is our ability to deal with that context learned?

Criticism of formalist models has frequently been grounded in one or more of these obstacles (criticism based on a perceived failure of the formalist model to adequately treat each obstacle). Offering a plausible treatment of each obstacle that is consistent with the neural network model and that incorporates the notion of culture is the challenge faced in this chapter.

Processing Limitations

Hall provides an initial indication of how the processing limitation problem might be overcome:

> "One of the functions of culture is to provide a highly selective screen between man and the outside world. In its many forms, culture therefore designates what we pay attention to and what we ignore. This screening function provides structure for the world and protects the nervous system from "information overload'." [Hall 77:85]

Hall's contention that culture plays a significant role in reducing the processing demands placed on conscious awareness can be interpreted two ways, only one of which is consistent with the position being developed here. The inconsistent interpretation arises from Hall's use of culture to focus attention on "significant" aspects of the outside world.

In physiological terms, the information that is ignored is that which is most constant. If culture functioned as a screen that focused attention on a particular set of external features then those features would be the most constant and hence the most likely to be ignored. This argument is inconsistent with the observation that the most "noticed" objects in our awareness are those that are the most unusual or out of the ordinary - not the reverse. It is also inconsistent with Hall's greater argument, to the effect that most of culture is "hidden."

The alternative interpretation of Hall has culture actually subsuming much of the "information processing" required in any given situation. Culture can be seen as a "pre-processing filter" in the sense that it subsumes a significant, if not a majority, part of the information processing required in any given interaction thus hiding (or screening) it from conscious awareness.

Limitations on conscious processing of information are bypassedg;, culture provides a majority of the processing required behind the scenes, non-consciously. Culture also ameliorates the processing speed problem by "pre-processing" much of the "information" leaving only a tractable minimum for the brain. [Additional discussion of this mechanism will be presented later in this chapter.]

A clearer indication of what Hall is asserting can be derived from his definition of high versus low context communications.

> "A high-context (HC) communication or message is one in which most of the information is either in the physical context or internalized in the person, while very little is in the coded, explicit, transmitted part of the message. A low-context (LC) communication is just the opposite, i.e., the mass of the information is vested in the explicit code."
>
> The level of context determines everything about the nature of the communication and is the foundation on which all subsequent behavior rests (including symbolic behavior)."
>
> [Hall 77: 91,92]

Given this interpretation we would expect that behavior, even complex cognitive or symbolic behavior, to be partly predictable in terms of cultural settings independent of any individual, conscious, cognitive processing. Hall cites the work of Roger Barker, a transactional or

ecological psychologist, whose reported results confirm this expectation.

> " ... the environment is seen to consist of highly structured, improbable arrangements of objects and events which coerce [Hall's emphasis] behavior in accordance with their own dynamic patterning. We found that we could predict some aspects of children's behavior more adequately from knowledge of the behavior characteristics of the drugstore, arithmetic classes, and basketball games they inhabited than from knowledge of the behavior tendencies of particular children ..."

[Barker 68: 4, quoted in Hall 77: 99]

Although Hall offers a convincing argument for high-context and low-context communications (communications being broadly interpreted to include individual interactions with the environment as well as interactions with other individuals) he offers no hint of a mechanism whereby information can be "vested" in context.

A potential mechanism is offered by the neural network model proposed in the last chapter. In terms of that model a given behavior (output of the network) was metaphorically related to the topology of that network which, in turn, was generated (shaped) by the inputs to which the behavior is a response.

It was further argued that features of a network topology reflected inputs of greater and lesser regularity.

Persistent features reflected the presence of highly regular inputs. Persistent topological features predispose the network to "settle" to a particular subset of states - states associated with specific outputs or behaviors. Metaphorically, a mountain range (presence of high-regularity inputs) predisposes runoff (settlement) to a limited number of ponds, lakes, and oceans.

From this perspective, Hall's high-context equates to a situation (set of total inputs at a particular time in a particular place) where there is a preponderance of high-regularity (and therefore non-conscious) inputs in the distribution of total inputs. Similarly a low-context situation is one where the preponderance of inputs are low-regularity.[2]

2 What constitutes a low-context situation is problematic, because Hall's distinction between the "coded" and the "contextual" parts of a message is not preserved in this model. Both high and low regularity inputs are simultaneously operative in the network. The relationship among inputs is of duration (low-regularity inputs are more ephemeral in their impact) and of constraints (high-regularity inputs constrain the impact of low-regularity inputs), but emphatically is not of separation into distinct input modes. This problem will be discussed further in subsequent sections.

High-regularity inputs shape general but persistent features of the network topology. Low-regularity inputs shape the specific and less enduring aspects of the topology. Since a given output (behavior) is a process outcome of the topology as a whole, the model indicates how a given behavior is dependent upon the presence of both high and low regularity inputs in a given situation.

The effect of high regularity inputs on a network (and the means whereby part of the processing limitations of a network are overcome) is to "hardwire" or optimize the network. Most of the major features of a network topology - which is the processing complement of its environment - is constantly maintained via high regularity inputs. Because any given cognitive task requires utilization of all inputs - is a function of the total topology - the fact that much of that topology is fixed reduces the processing load to the handling of only the low regularity inputs. The association of high regularity inputs with non-consciousness is a side effect. It may be useful to speak of conscious and non-conscious inputs (or processing), as Hall does, but the critical issue here is the variable regularity of inputs.

At this point the model offers only the barest foundation for an explanation of the role of culture in shaping a neural topology - through variation in the

regularity of the inputs provided to the network. What is required next is an accounting for the presence of specific mixtures of inputs and how they relate to cultural situations. That accounting will be the subject of the next section.

Organization

Most organisms are able to adapt to a range of variation in their environment. Most are able to modify their environment to some extent.[3] Human beings are unique in the range of their adaptational and modification abilities. The ability to modify the environment is of central interest, for it is by making such modifications that human beings can limit, alter, or select a particular set of inputs and fix them in a particular place. A simple example is painting my house, an action that ensures a particular chromatic input to all subsequent observers.

Modifying the environment so as to fix a given set of inputs will be considered the construction of an "Input Complex" (IC). An IC is a subset of the total number of inputs available from the environment at any given time, in

3 Such modifications might be the result of simple reflex. They are observed throughout the biota, even to the level of enzymes within cells.

any given place. Many ICs can be present in the environment simultaneously.

In general the inputs comprising an IC will equate with sensory stimulii.4 Generally an IC will be characterized on the specific nature of the inputs (high versus low regularity) and duration (how long the modification persists in the environment). Some examples: building a sand-castle is high-regularity and transient; uttering a sentence is low-regularity and ephemeral; building a monument is high-regularity and enduring; and inscribing the monument is low-regularity and enduring. As the monument example indicates, most ICs will involve a mixture of characteristics.5 An IC realized as a physical object can "store" its high-regularity inputs for a considerable period of time. If the object is portable the inputs will also be conserved over distance. Perhaps the most straightforward and non-controversial example of preservation is a book.6

4 A major exception would be inputs from "within the skin" which range from internal "sensations" like hunger to the presence of a particular hormone or chemical in the brain.

5 A consequence of storing a range of high and low regularity inputs in a single situation is the differential persistence among stored inputs. A monument like Stonehenge, for example, continues to store high-regularity inputs - sensory stimuli - long after the low-regularity inputs have faded away or ceased to be significant to observers.

ICs are crafted (sometimes consciously and with foreknowledge of the results, sometimes not) to evoke a particular "state of mind" in individuals encountering those situations. (In terms of the model, state-of-mind is literal as well as figurative as the evoked "state" is nothing other than a specific topology.) Once crafted, an IC is public and shared in the sense that inputs stored therein are

6 It is important to remember, however, that a text literally preserves only a subset of inputs - a subset that will evoke an awareness of certain kinds of associated lines and curves clustered according to a larger pattern. In the absence of additional "contextual" inputs the text will lack "meaning."

It is generally impossible for any situation to store the totality of relevant inputs. However, both the range and the balance between high and low regularity inputs can be selectively stored.

The range option is illustrated by the construction of a cathedral which stores a much wider range of inputs than a scriptural text.

The second option is less obvious. Keeping in mind that inputs can be scaled according to their regularity (what Hall calls context), low-regularity inputs have a much shorter "shelf-life" than high regularity inputs. Basic sensory impressions, for example, exhibit high regularity, but arbitrary codes, like languages, have relatively low regularity. A movie which contains direct sensory inputs is more likely to be comprehensible after a significant period of time because its high-regularity (sensory) inputs are less prone to change than unadorned text.

simultaneously available for reception by every individual encountering that situation.

By virtue of their public nature, ICs provide the foundation for a rudimentary system of communication among individuals. For example: a simple unarticulated but high volume sound modifies the sensory environment for a short period, a period sufficient to evoke a fearful state-of-mind in nearby others; or, remembering that the human body is part of the modifiable environment, assumption of a particular posture evokes a desired response from an observer.

Communication via IC provides the first vestiges of a culture. Although such simple examples as above are obviously inadequate to account for culture in its usual anthropological sense, they do offer a beginning. It is necessary to expand the definition of an IC to account for the larger conception of culture. One avenue of expansion, suggested by the neural network model begins with the use of "kernels."

It was argued in the previous chapter that one aspect of a network topology was as a representational complement of the process whereby a given output was linked to a given input. It was also argued that, once formed, it was possible to re-establish (or maintain) the topology with a

percentage of the original set of inputs. The smaller set (the kernel) would evoke the state-of-mind (and consequent behavior[s]) that the entire set would have done were it present.

Invoking an IC through a kernel is analogous to invoking the state of piety one might experience in a cathedral through the simple presence of a crucifix, or the evocation of grandmother's kitchen through the scent of fresh cinnamon rolls.[7]

Replacing ICs with kernels provides a mechanism for increasing the "input density" (complexity of topology invoked divided by the number of inputs) of the environment. Kernels are also more likely to be portable and durable, which enhances the general role of ICs as discussed above. The full contribution of kernels, however, is realized only in conjunction with principles of recursion and redundancy.

First consider redundancy. If the percentage of inputs required to create a kernel is 25% of the total inputs, and if a given IC stores N inputs the number of potential

7 More than analogy is at work here. Subsequent discussion will address the possibility that the IC-reduced-to-kernel mechanism is

generally applicable to input sets whether external or internal in origin.

kernels that could invoke that IC is given by the formula:

$$(N - .25N)!$$

Because a kernel is defined only as a percentage of the inputs stored in an IC and not a specific subset of those inputs, any given IC is likely to be replaced with a large number of kernels. Not only will the smell of cinnamon rolls evoke grandmother's kitchen but so too will a flour dusted apron. The apron will also evoke the smell of the cinnamon rolls.

Redundancy affects the input environment in three ways. First, it increases accuracy. An increase in the number of kernels present increases the "resolution" of the invoked network topology the same way that the resolution of a hologram is improved with an increase in the size of the re-creating fragment. [See Chapter Five]

Second, it is almost inevitable that there will be overlap among kernels so that any given kernel can participate in more than one invocation of a network topology.8

8 The discussion so far is treating ICs, kernels, and topologies as if they occured discretely. This is an artificial restriction adopted to reduce the level of complexity in the discussion. Later in the chapter the restriction will be removed and the full dynamics of the environment and the invoked topology will be discussed in greater detail.

Third, redundancy increases the consistency of inputs and therefore contributes to a general shift in the balance of inputs from low-frequency to high-frequency. This trait is significant in conjunction with the influence of recursion, discussed next.

Creation of kernels is a process subject to recursion. One or more kernels can be present in a IC which can then be "reduced" to a kernel itself. For example, conside a "real time event" like the onset of puberty for an Ndembu girl. An IC, in the form of a ritual, provides an appropriate set of inputs to the participants. Some components of the ritual IC are kernels invoking topologies involving several related ICs of Ndembu life, one of which is the mudyi (milk tree, Diplorrhyncus Condylocarpon) sapling. [Turner 67:20] As a kernel the mudyi provides inputs that recall not only the ritual but all of the recursively enfolded aspects of Ndembu life associated with that ritual. Both Turner and Geertz eloquently describe the "unfolding" which is required to discern the cognitive influence of the, seemingly, simplest object in a cultural environment.

The kind of organization (the focus of this section) that is provided by the neural network model under consideration is somewhat alien to the common understanding of the term. In formalist and computational models,

organization is the relationship between a set of well-defined entities.

However, the desire for organization was prompted by the need to reduce processing demands arising from the need to respond to a complex environment. In terms of the neural network model this need translates to the generation and maintenance of a complex topology subject to a dynamically changing set of inputs. By allowing the recursive "collapse" of complex ICs into kernels more and more inputs are shifted from low-frequency to high-frequency. In addition to removing those inputs from conscious awareness, this process effectively eliminates the need to "process" significant portions of the input environment.9

Although significant reductions in processing demands (perhaps gains in processing power) are realized with this

9 There is a subtle and partially erroneous distinction made between the flow of signals through a computer and the manipulation of those signals in response to programmed directives. Operations that have been "reduced to silicon" are not usually counted towards the processing volume of the system. This is an error in terms of any strict definition of processing, but it does illustrate how processing gains can be obtained by deliberately configuring the processor in an optimal fashion. Examples of this process include RISC machines and LISP processors. In the neural model the "hardware" is not changed but the virtual topology is; and, with an analogous gain in processing power.

model and its mode of organization, the environment and the topology of the neural network remain extremely complex and "information dense." This points to the remaining obstacle, how an individual "learns" to apprehend and respond to the cognitive environment.

Learning

D'Andrade exposes the depth of the learning problem and, inadvertently, a significant limitation of the formalist approach to learning.

> "It is a significant fact about human culture that for the past 50 thousand years, the total amount of information transmitted from generation to generation has been increasing rapidly. Each generation has added some of its discoveries to the total stock of 'pass it along' type information.
>
> One way to measure the size and importance of this transmitted pool of information we call 'culture' is to observe the things and events surrounding oneself, and note how much of one's environment is a product of this informational pool.
>
> An interesting issue concerns the size of the cultural information pool. Quantifying information in terms of 'chunks', or symbolic units which can be held in short term memory, it has been estimated that about 50 thousand chunks are required to play chess at the Master's level, or speak a language with a reasonable proficiency. Given this estimate, a figure of several hundred thousand chunks for all the cultural

> information known by a typical adult is quite conservative. Upper limits can be obtained by considering time constraints; e.g., to learn ten million chunks would require that one learn more than a chunk a minute during every waking hour from birth to the age of twenty.
>
> This estimate of several hundred thousand to several million chunks per individual does not indicate how large

> the total cultural pool might be, since one of the characteristics of human society is that there is a major division of labor in who knows what. The total informational pool carried by the entire population of a society might be something like a hundred to ten thousand times the amount that any one person knows, yielding estimates of the total cultural information pool ranging from a few million to ten billion chunks of information.
>
> Just the maintenance of such a large pool entails a number of remarkable engineering problems. For example, how can things be arranged so that all this information gets learned again and again without serious loss or distortion? How could one know if the information were lost? How can procedures be established so that the person who has the appropriate information is there when needed? How has it all been arranged in the past, and how can it be arranged in the future when it is likely there will be an even bigger pool?
>
> [D'Andrade 81: 179-181]

First, D'Andrade reminds us of the complexity of the environment - how much information is really "out there." When he attempts to put a numerical value on that store of information, however, he seriously underestimates its

extent. Even if his cultural information figure were reasonably accurate he ignores information from non-cultural (i.e., phsyiological or analytical) sources that must be handled by the same processor - a human brain.

Second, he reminds us that the information must be "learned." In his context learning is the transfer of the information from the external world to the internal world of the mind - a process closely analogous to the transfer of data in a computer from one medium of storage to another. Difficulties inherent in even this simplified conception of learning are formidable, as D'Andrade points out. Considering "real world" difficulties like the need for repetition in learning, the observed inability to accurately pass information from one person to another, etc., the fact that any learning takes place at all is truly remarkable. So remarkable, in fact, that perhaps a different mechanism is required to account for it.

Third, D'Andrade points out the need for "meta-information" to organize information both for learning and for efficient storage and retrieval in individual minds. This meta-information obviously increases the total store of information that must be preserved, learned, and managed.

On the one hand, D'Andrade's observations raise anew the problems that have led to numerous objections to the

formalist position (see Chapter IV), but they also point out an incipient distinction between information and how to make use of that information.

Most of the cultural information we have available did not result from a process of formal or explicit instruction and it is often hidden from our conscious awareness, yet it is readily used when the situation demands. The learning problem would be significantly altered and ameliorated if the information itself were innate and learning were reduced to the correct recall and application of that information.

Referring again to a computer analogy, this would be as if the hard-disk came pre-loaded with all necessary software and data. This option would be difficult to pursue from the formalist perspective because it seemingly leads into the realm of mysticism and unexplained "first causes."[10] It may not be so problematical from the perspective of our alternative neural net model.

The topology of a neural network is "its contents," the equivalent of a mass of information or data stored in the memory of a conventional computer. That topology is shaped

10 Which does not stop some formalists. Chomsky, for instance, ultimately must assume the existence of innate (genetically explained) principles which serve as the foundation for transformation processes.

and maintained by the inputs fed to the network by the external environment.

From the perspective of the model there is not a vast information store "out there" which needs to be replicated inside the mind. What is "out there" is a vast collection of inputs. "Learning" is the shaping of a virtual topology in response to those inputs.[11]

In a neural network model training is usually limited to a small selection of discrete input sets. The human mind, however, is confronted with the task of learning the totality of the environmental inputs simultaneously. If the training of small artificial models requires tens to hundreds of iterations before the topology settles to its desired state then the training of a human mind must require millions of iterations.

At first glance the requirement for millions of iterations would seem to raise an objection similar to one levelled at formalist models - there isn't enough time.

10 Technically, the learning process requires some kind of feedback. This feedback need not come from outside the network; unsupervised learning is common. Except where explicitly noted otherwise the feedback aspect of the learning process is implicit in the direct response to the inputs from the environment.

Further reflection recalls that although the brain functions slowly in comparison to a computer it is still very fast, offering millisecond cycling time. Because the brain operates in a massively parallel mode it is possible to re-configure the topology with a very limited number of cycles (perhaps five). Given these figures the number of training cycles available per year exceeds 60 million.

A second possible objection concerns the fact that learning is incremental. How is incremental learning reconciled with the fact that the human mind deals with simultaneous inputs from the environment-as-a-whole? A plausible answer arises from the difference in regularity between some inputs and others. High-regularity inputs are presented nearly every cycle and it is reasonable to expect them to be "learned" faster than inputs that appear less regularly. Work with neural network models confirms that frequency of presentation improves learning performance. [McClelland, Volume 2]

In terms of the geology metaphor, the environment is learned from the "core" outwards. If the total number of inputs received from the environment at any given time is arranged as a spectrum, then:

1) A large number of inputs at one end of the spectrum are those originating from the cellular,

organismic, and sensual realms (core, tectonic plates, and planetary crust). They are high-regularity and are learned rapidly. They contribute the most general and enduring features of the network topology.

2) The middle portion are those originating in deliberate modifications to the environment - ICs and kernels - or culture (geography). These are learned less quickly than the previous category, but still rapidly. They are reflected in the enduring mid-range features of the landscape.

3) A large number at the opposite end originate in individual habits and analytic thinking (landscape and architecture). These are the lowest frequency and are learned less rapidly. They are also more subject to change and are reflected in the details of the network topology.

Because the first and second input ranges involve high-regularity inputs, the learning associated with those ranges is mostly non-conscious.

Learning, from the perspective of the neural network model, is nothing more than an Adapt-Test-Modify-Adapt cycle reminiscent of biological evolution. The major differences include the speed of the cycle and the fact that the adaption is of a virtual rather than a biological entity.[192]

The model does not involve any kind of transference of information from the environment to the mind or replication of information in the mind. Several issues concerning cognitive structure are affected by this aspect of the model; two of which (the nativist argument applied to deep cognitive structure, and the notion of a "collective memory") will be mentioned briefly.

The topology assumed by the network is reflective of a significant amount of structure in the external environment. (In the cases of the second and third ranges of inputs that structure results in large part from modifications imparted by human action.) However, none of that structure is "in the mind" although it is "reflected" in the virtual topology of the network.

The only "structure" that can be directly attributed to the mind is the generic architecture and the simple rules that govern neuron firing and connection weight adjustment. This observation refutes arguments, like Chomsky's, that the mind has an innate (not learned) deep structure that is the ultimate foundation of transformationally generative processes which give rise to more complex cognitive structures.

As noted in the introductory chapter, the neural network model seems to indicate that what Chomsky sees as

innate structure of the mind is really nothing more than the structure implicit in the input environment to which the mind (by virtue of the representational complement nature of its topology) is an adaptation.

Collective memory ("collective unconscious" for Jung, one aspect of Weltschauungen for Dilthey) is an idea that has been proposed in many contexts to support various ends. In most instances it has been invoked to explain the ability of humans to exhibit behaviors (especially those that would be considered cultural behaviors) or apprehend meaning in situations where they have received no formal or overt training.

The notion has usually been dismissed as somehow being too metaphysical or mystical to be used in "real" science or philosophy. A perhaps acceptable interpretation of "collective memory" is that it is simply the storage of collective information, as in a library. The neural network model offers another interpretation of collective memory that falls somewhere between the mystical and the mundane.

Biologically, all humans share the same basic capabilities to respond to the physical environment. Inputs from the environment in cellular, organismic, and sensual ranges shape the topologies of individual minds in essentially the same fashion. The most general and most

enduring features of each individual topology are therefore likely to be functionally similar.

The cultural environment is a collective product, the result of a multitude of individual modifications individually applied. It is also public. The inputs stored in that environment are simultaneously available for reception by every individual encountering that environment. Therefore, the topology of each "individual mind" is further shaped by a common set of inputs, resulting in additional functional similarities. Inputs that are stored in the public environment are appropriately considered as a kind of collective property. Those inputs can be considered a collective memory.

Because so much of the general topology of mind is shaped by publicly shared, high-regularity, inputs a majority of the "learning" process takes place without the attention of consciousness, intercession by explicit mechanisms of learning, or the overt influence of other humans. What is commonly perceived as education is little more than the "fine-tuning" or finish landscaping of a topology already well defined.

Mind? and Culture?

Two familiar terms, culture and mind, have been used throughout this chapter. Culture has been equated with a portion of an overarching environment which consists of "raw inputs." Mind has been equated with a virtual construction - metaphorically a topology - that arises from the neuro-physiologic process of inputs from the environment. Although the terms are familiar and the assignment of one to external phenomena and one to internal is reasonably conventional, the overall presentation is alien to commonplace definitions of the two terms.

When it has been necessary to discuss organization or structure in either the cultural or mental realm, every effort has been made to avoid standard terminology like ritual, script, schema, symbol, taxonomy, category, frames, class, networks, roles, rules, social relations, symmetry, etc.. Most of these terms imply a degree of formalist orientation in the analyses that employ them, even those that are interpretivist or hermeneutic in intent. (One of the difficulties in presenting a hermeneutic argument is, in fact, the lack of an adequate terminology - one without the formalist connotations present in most of the anthropological vocabulary.)

The purpose of both efforts has been the "un-defining" of mind and culture or, more accurately, the replacement of conventional understanding of those terms with a new understanding consistent with the neural network model of cognitive processing. A secondary purpose has been the establishment of an alternative, wholistic, "unit of analysis" which is also consistent with the neural network model. A summary recapitulation of the new definitions will conclude this chapter, and the ends to which these new definitions will be put will be taken up in Chapter VII.

The "un-definition" of culture begins with the concept of an environment - a vast source of sensory and extra-sensory inputs. (Extra-sensory inputs either originate "inside the skin" and therefore bypass the senses or are the result of direct molecular, chemical, or, perhaps, even atomic interactions well below the sensory threshold.) A first-order organization of the environment arises from spatio-temporal relationships among the inputs. (Some of them come from roughly the same place at the same time.) A second-order organization arises from the limited perception capacity of the biological organism. (Humans cannot perceive X-ray inputs, for example.)

Culture comes into play when human actions cause modification of the first and second-order organization

thereby generating a third-order patterning of the environment. Environmental modifications ensure that a given set of inputs will be received by other sensory-capable organisms (usually other humans) who are already in contact with that environment or who will come into contact with it at a future time.

Fourth-order through Nth-order organization is achieved by "collapsing" third order organization into a kernel - a subset of inputs that can generate or maintain a perception of the environment equivalent to that perception evoked by the total set of inputs.

Another kind of order (imposed along a skewed or perhaps orthogonal dimension) is present in the environment - based on the "regularity" of a given input. A sensory input that is an attribute of an enduring set of environmental inputs (what is perceived as an object) will be present in every encounter with that environment. An example is painting a house. Inputs that are attributes either of ephemeral input sets (sounds for example), or of "objects" which appear in the environment only occasionally, have low regularity.

Both learning and familiarity are functions of regularity. For example, letters of an alphabet appear continuously in the environment of a literate culture and

are therefore readily apprehended; they are high-regularity inputs. Words, specific combinations of letters, occur with less regularity than letters and are less easily apprehended. Sentences exhibit even lower regularity, and full texts still less. The full significance of regularity as a dimension of ordering of the environment will be part of the "un-definition" of mind.

The un-definition of culture ends with an environment consisting of a vast collection of inputs, some of which are organized as a result of human actions. Culture, un-defined, is not a "thing," is not a proper object of study. "Cultural" inputs are indistinguishable from all other inputs in the maelstrom that is the environment-as-a-whole. Even where it possible to isolate certain inputs and say "these are cultural" they offer little for the investigator because they are sensible only in terms of the response they evoke in an apprehending mind.

Most of the un-definition of mind was accomplished in the last chapter when the popular computational model was replaced with the neural network model. It was completed in this chapter with the equation of mind with a topology, a virtual rather than physical entity, that is generated through an unceasing Adapt-Test-Modify-Adapt operational cycle.

The virtual topology can be regarded as both a representation and a representational complement of the input environment. As a representation, the topology as a whole is a kind of reflection of the input environment. This is a consequence of the distributed representation mode of neural networks as discussed in Chapter V.

As a representational complement, the contours of the virtual topology are akin to lines of potential that channel inputs to a point of stability which conforms to a set of outputs, which are often organismic behaviors. The association between the presence of a particular set of inputs and a behavior derives from the organization of the environment - not any independent organization of the mind.

The aspect of the environmental organization that is most responsible for "shaping" the network topology is regularity of inputs. As regularity increases the learning interval decreases and the persistence of topological features subject to those inputs increases. As a consequence the topology of mind is first and foremost a result of inputs originating in biology and the senses (natural inputs) and secondarily the result of inputs originating in human modification of the environment (cultural). The least regular inputs are those originating from habitual and analytic behavior. In terms of the

metaphor: natural inputs form the mountain ranges and watersheds; cultural inputs form the streams and rivers; habitual inputs form the ponds and lakes; and, analytical inputs form the delta at river's mouth.

It is important to remember that the mind is not a repository of information about inputs or their organization. Although the topology of the network has loosely been described as a kind of representation of the totality of the environmental input set, the only information that can be considered "stored" in the mind is the processing information - how to channel inputs to appropriate outputs.[11]

Examination of the mind independent of its environment will reveal little beyond the fundamentals of its architecture, details of its neuronal and cellular properties, and perhaps some mechanisms whereby it stores inputs in the environment. None of those findings will lead

11 This does not mean that the brain (and the body) are not depositories of information - or at least of inputs. There is not difference in principle between changing the chemical structure of a cell, neuron, or even a synapse and the painting of a house. Both are instances of inputs being stored in the environment - external to the topoplogy of the network which is generated upon receipt of inputs.

to an understanding of the topology which is generated and maintained only in the presence of environmental inputs.

Undefined culture is a maelstrom of inputs. Any discernible organization or patterning of those inputs is sensible only in terms of the mind and its topology which arise from their perception. Un-defined mind is an architecture capable of virtual (rather than physical) adaptation to a complex input environment. Knowledge of that architecture provides little insight into the its performance in the presence of the input environment.

Apart, mind and culture are reduced to objects that are generally untractable to any kind of analysis which might lead to an understanding of cognition. Together they form an exceedingly complex and highly dynamic system. If that system is taken as an undifferentiated unit of analysis then the concept of mind advanced by the hermeneuticists is realized - mind, meaning, cognition are inseperable from culture and the larger environment.

Combining mind and culture (and ultimately biology) into a single entity does nothing to reduce its complexity. The system remains complex, dynamic, and probably non-deterministic. What kind of analysis, particularly anthropological analysis, is possible for a chaotic system? This is the issue addressed in the final chapter.