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The Story As The Engram; Is It Fundamental To Thinking?

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The following paper presents "the story" as the basic unit of learning and memory corresponding to Lashley's engram. The reasons why Lashley's engram was never located are discussed, as are the organizational and structural properties of the story that, in light of data from both human and infra-human research, make it the basis for cognitive cohesion. It is further suggested that the story may: (1) in its universality represent Chomsky's "deep structure" and in its component parts "universal grammar," (2) explain how the CNS has overcome the limits of "chunk" size during information processing, (3) suggest how memory is stored and retrieved, and (4) explain the ontogeny of human logic — or the lack of it.

From the time of ancient Greece to modern psychology, there have been two opposing views about how thinking is organized. These opposing views can be summarized by a deceptively simple either/or question. Is how we think determined primarily by experience, or is our brain already partially programmed and therefore, the brain itself, determines what we learn and perceive? The choice of views is important not only to neuroscience and psychology, but to every school child — for it influences how and what the child is taught in our schools.

The view that experience is our main organizer is shared by both Aristotle and modern stimulus-response psychology.[1] Aristotle hypothesized that the human mind is initially a blank slate on which are etched, through experience, tiny segments of information that can lead to a totality of knowledge. The interesting resemblance of this view to modern computer programming was utilized by stimulus-response psychology in its development of programmed instruction. Using modern terminology: Small segments, "bits," are mastered one by one, usually by rote, presumably leading to an understanding of the whole.

The opposing view, that the mind is already partially organized, and therefore itself determines what we learn and perceive, was hypothesized by

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[1]A good review of the relationship between modern stimulus-response psychology and Aristotle can be found in: Boring, E. *A history of experimental psychology*. New York: Appleton-Century-Croft, 1950, pp. 219-233, 620-659.

Plato.[2] The 18th-century philosopher Kant systematized this view with his observations that the human mind is organized to grasp certain ideas but not others. Darwinian evolution gave a scientific logic to Kant's reasoning which modern Gestalt psychology placed in an experimental framework, showing that what is perceived by the brain can be different from what is seen by the eyes (Koffka, 1935; Köhler, 1940; Wertheimer, 1945). On a neurophysiological level, Lashley (1950, 1963) searched for the localization of memory units, or engrams, as he termed them. However, the engram turned out to be astonishingly elusive, and Lashley hypothesized "mass action" of cortical tissue as the explanation for memory.

The psychology of gestalts or wholes, which implied that the CNS was preprogrammed, led to holistic teaching within the classroom situation. Köhler's (1924) insight experiments with chimpanzees were further developed with children by Lewin (1946). However, in spite of the interesting findings that emerged from the Gestalt experiments, holistic teaching, contrary to the stimulus-response approach, did not lend itself to the simple classroom prescriptions demanded by the growing needs of mass education. Instead, the needs of mass education were met by the segmental and rote teaching approaches that fit the theoretical framework of stimulus-response psychology.

The segmental and rote teaching approaches were reinforced by another development of mass education — the IQ test. The mass classroom setting made it necessary to find out who the prospective failures would be, since these individuals slowed down mass instruction. To answer this question, Binet and Simon (1905) sampled skills of the classroom, and made these skills the subtests of their IQ test. McClelland (1973, p. 1) describes what happened: "The games people are required to play on aptitude tests are similar to the games teachers require in the classroom. In fact, many of Binet's original tests were taken from exercises that teachers used in French schools. So it is scarcely surprising that aptitude test scores are correlated highly with grades in school." Inadvertently, because they arose out of the same needs, there developed a symbiotic relationship between IQ tests and rote and segmental teaching.

This symbiotic relationship was further reinforced by Spearman, who had found that the Binet-Simon test and others developed subsequent to it, correlated with one another. Spearman (1927) hypothesized that the tests correlated because they were measuring the same thing, which he called "g" for general intelligence. The construct "g" was subsequently questioned by

[2]The modernity of Plato's view is reviewed by Walter B. Weimer in his article Psycholinguistics and Plato's paradoxes of the Meno. *American Psychologist*, 1973, *28*, 15-33.

Thurstone (1938) whose statistical analyses of the tests showed numerous factors involved in intelligent behavior. But in spite of the questions raised by Thurstone and a legion of other psychologists (e. g., Anastasia, 1935; Tryon, 1979), coupled with the observation that "geniuses" often did not have high IQ scores or were precocious as children (Albert, 1975; Cox, 1926), the needs of mass education made IQ tests ever more popular. Now, almost 80 years later, "IQ" has become a part of our culture, and the test items are frequently assumed to be descriptive of the cognitive hierarchy of our species — despite the contrary findings by many cognitive psychologists that intellectual functioning is much more complex than the IQ score would have us believe (Hilliard, 1975; Hunt, 1961; Kagan, Moss and Sigel, 1963; Piaget, 1970).

Indications within the "IQ" test. My own experience with IQ tests had been that they were reliable instruments and predictive of school performance (Fuller, 1967; Fuller and Shuman, 1969, 1974). More or less, they seemed to reflect what I thought of as cognitive hierarchy. Then unexpectedly, in my own laboratory, the IQ tests failed to do what they had always done; predict school performance. What produced the unexpected findings was a novel method for the teaching of reading. This approach had been intended for superior dyslexic students and therefore made extensive intellectual demands upon the child. Its success with dyslexic students was expected, but not with severely retarded subjects[3] (Fuller, 1979a, 1979b; Fuller, Shuman, Schmell, Lutkus, and Noyes, 1975). Reading comprehension and test performance of these retarded subjects was so outstanding, and so contrary, to what one would predict on the basis of their IQ scores, that it forced me to rethink many psychological assumptions. Eventually the data suggested a preprogramming of the human mind which would not only explain diverse psychological phenomena, but could be tested on different levels of cognitive and neurological organization.

The novel teaching method which had produced the unexpected findings introduces word building with the learning of the second letter and story reading with the fourth letter — very different from a rote or segmental approach. The letters themselves are made more easily recognizable by showing how they can be built with three basic forms: a circle called a ball, a line called a stick, and an angle called a bird (Fuller, 1974b). The student is told that letters represent a sloppy code, and that in order to decipher the code one has to be like a detective and play around with the letter sounds until they make a word that makes sense in the story (Fuller, 1974a). This process is

[3]Originally presented as a symposium on Ball-Stick-Bird at the meeting of the American Psychological Association in 1972. Brought up to date in: Fuller, R. *In search of the IQ correlation.* Stony Brook, N.Y.: Ball-Stick-Bird Publications, 1977.

called "code approximation." Since it requires considerable intellectual feedback, I had expected it would be impossible for the very young or the retarded. However, reading with comprehension by students with Stanford-Binet IQs as low as 20 has been achieved again and again. Inadvertently, I had stumbled upon an alternative to the segmental and rote teaching approaches that are so popular in today's classroom.

Early in the experimentation it became apparent that story context, which the subjects deciphered with "code approximation," helped in the learning of information "bits" like the alphabet. Reading tests showed that words embedded in a sentence produced significantly higher scores that when the same words were presented in word lists. This was especially pronounced in the very low IQ subjects. The higher IQ subjects found it easier to read out-of-context words than the more retarded (Fuller, 1977).

In spite of the advanced vocabulary of the books, understanding a story was easier for our retarded subjects than such simple rote tasks as learning the alphabet. Had the method tapped into something fundamental to the human brain? Is it that stories are essential to thinking?

Even among the retarded, there rarely is someone who cannot follow a story. We had two such exceptions in our original study. These two patients, contrary to the other subjects, were never able to follow a narrative although they learned to read isolated words. They remembered little about their own lives, even though they could remember isolated facts and had fairly good vocabularies. Neither individual could make sense out of what was going on around him; they could not make the simplest story out of their experiences. In spite of relatively high IQs, they could not function with the facts and skills they had. Most intriguing was that both patients had almost continuous petit mal seizures, which, because of their repetitive electrical discharges, may have prevented memory traces from being established that would have connected isolated knowledge "bits" into a coherent whole.

In some ways these two patients were similar to deteriorated schizophrenics whose IQs have remained within the normal range but who are unable to function in the real world. What such schizophrenics are unable to do is impose a structure on reality, that is, to tell a coherent story about it. Although such an incapacity implies an inability to deal with reality, it does not necessarily mean a retarded IQ. The schizophrenic who has these problems can still function in ways similar to a computer, because most of his or her knowledge banks have remained intact, but their use in making a cohesive whole out of this knowledge is gone.

We had another patient who demonstrated the importance of story cohesion in learning and thinking. Contrary to the two petit mal cases, this patient could always follow a story. In fact he told the most marvelously outrageous tales. However, partial cortical blindness prevented him from recognizing alphabet letters. Even when two letters were presented side by side, he had difficulty in telling whether they were the same or different.

We took this patient into our study to see if his capacity to follow a story could bridge the cognitive gap of his graphic aphasia. Much to our astonishment and delight, he did learn to read. But even after reading fluently, when shown the letters separately, he was frequently unable to name them correctly. Evidently, story content could make his brain draw conclusions about the letters it had trouble seeing. Rather than the segments, that is, the information "bits," leading to the understanding of the whole, our subject had grasped the whole without always recognizing the parts that made up the whole.

The Story in Child Development

All but ignored by learning theories and IQ tests, story comprehension appears surprisingly early in child development. By the time a normal child is two, he or she can follow a simple story (Gesell, Halverson, Thompson, Ilg, Castner, Ames, and Amatruda, 1940), and 50% of two-year-olds can respond to the instruction "Tell me a story" (Ames, 1966). Prior to this, a child may know only a few words. Then almost overnight there is an explosion of vocabulary and the child is able to make sentences. They may be only two-word sentences, but they are already a miniature story, and thereby, are conceptualizations implying meaning. These sentences show that the child has learned to impose a structure on reality, a structure that takes the story form. Just as an advertiser can tell a miniature story in 24 seconds, so can the child.

Applebee's (1978) charming review, *The Child's Concept of Story*, deals with the different types of stories that are told at various age levels. In the same way Pitcher and Prelinger (1963) analyze the development of fantasy as exemplified by the kind of stories children tell. Bettelheim seeks to unravel the emotional implications of *The Uses of Enchantment: The Meaning and Importance of Fairy Tales* (1976). But the question whether the story functions as our cognitive organizer remains unasked; as does whether the child's budding capacity to understand stories is linked to the development of intellectual cohesion, to logic, and to language development.

To my knowledge, no one has considered the neurophysiological reasons for stories having such a curious fascination for all of us. From age two, when we start to communicate in story form, we also spend hours glued to the television set. Wherever there were or are people, be they stone age or modern, these people listen to or tell each other stories. What is the function of this emotional and intellectual preoccupation? Is story cohesion fundamental to human thinking? Is it our cognitive organizer and the reason why all human languages take the same form?

The Story and Language Development

Although different languages vary phonetically, grammatically they are strikingly similar. Nouns from one language can usually be translated into another — the same holds for verbs, adjectives, and adverbs. Languages differ, for example, in whether they have articles, if the articles are gendered, in the number of prepositions, and in word order. However, these are minor differences: Irrespective of how isolated a society of people is, their stories can be shared — they can be translated into every other language.

Developmentally, children first learn those parts of speech, the nouns, verbs, then the adjectives and adverbs, that are the invarients of language structure. These are the parts of speech that are the same for all human languages. On the other hand, articles, connectives, prepositions, and even word order, which vary from language to language, are learned at a later age (Gesell, Halverson, Thompson, Ilg, Castner, Ames, and Amatruda, 1940; Piaget, 1959). It is intriguing that when as adults we learn a foreign language, we follow the same learning order as a child: first nouns, verbs, adjectives, and adverbs. Only gradually does the foreigner master those pesky little words, the articles, connectives, and prepositons. As for word order, which differs from language to language, this is the frequent source of amusing error.

Do human languages have analogous parts of speech (they all have nouns, verbs, adjectives, and adverbs) because they must all do the same thing — tell a story? These parts of speech do indeed represent "a universal grammar." Is the story the deep structure that Chomsky (1972) was vainly looking for? The story structure is invariably built in terms of things (nouns), that act (verbs), or are acted upon. The things (nouns) can have attributes (adjectives), and so on. How much of the neural encoding of experience uses this ubiquitous grammatical structure?

The similarity among languages, even in isolated areas of the globe, must surely imply that information is processed in similar ways. Certainly there are alternative ways of processing and transmitting information — but when we meet such alternate ways, as those used by insects, they are quite foreign to us.

The Story and the Development of Logic

The way we process information seems to be linked to the human need to make life coherent, to make a story out of it. Historically, we made a story out of our fate — the gods wanted to punish us, to teach us, to love us. But then these stories were often contradicted by events and by other people's stories. New stories came into being which were not as readily contradicted by events. There developed ways of testing whether a story would hold up. These improved techniques of testing the veracity of a story were the beginnings of science.

Science was to give us some of the most fascinating of all stories. In the 19th century, it told us the story of evolution and the origin of our species. In our 20th century, it was relativity and the story of the cosmos. And so, what we are most proud of, our logic, our rationality, seems to have its origin in story cohesion.

Developmentally, the first childish understandings of causality make their appearance with the story. "Johnny do it," "Jimmy did it," "Jane made me do it," are attempts at attributing cause and effect (Piaget, 1959), as well as our human tendency to overgeneralize. Overgeneralization does seem to enhance the story. It also makes the story simpler to understand. Even as adults, when we try to understand an interaction that does not readily translate itself into a story, we have considerable difficulty. But what we find the most difficult intellectually is the possibility that there might not be a story.

Those aspects of science which have an involved causality frequently lead to muddled thinking even by professionals. How often do we incorrectly assume that a correlation implies a causal relationship — the easy story —when it implies no such thing. Involved mathematical notations that do not readily translate themselves into a verbal story are extremely difficult for us to understand. Frequently we have to relegate these to our computers, so that the machine brain can deal with relationships that our story-engrossed brain has difficulty in comprehending. How often does a theory survive in spite of contradictory evidence, because it makes such a good story? Only when we have an alternative theory, an alternative story, do we let go of a faulty theory. How different would be our logic if the story were not fundamental to intellectual cohesion.

The Story as the Engram of our Species

The story as an essential in cognitive development would explain why blindness does not produce the thinking deficits and emotional disturbances of deafness. Those of us who have worked in defectology have seen what happens when a deaf child is taught American Sign Language. There is a burst of intellectual and emotional development. Like the hearing child, the deaf child becomes fascinated with stories. Furthermore, the reading deficits usually observed in deaf children can be avoided by teaching with stories which "substantially reduces the necessity for preteaching sentence structures and vocabulary . . ." (Ewoldt, 1981).

Are stories essential for the proper functioning of our nervous system? The attention and evident pleasure that are associated with stories imply an emotional valence usually reserved for behaviors essential to the survival of the species. Such behaviors, like eating, drinking, and sex, Freud's id functions (1959), or MacLean's functions of the reptilian brain (1975), have part of their neural representation in the subcortical pleasure centers of the brain. Do stories also have their neural representation in the subcortical pleasure centers of the brain? And how do they relate to consciousness?

If the story is an essential in cognitive development, could it be the basic unit of learning and memory that modern psychology was looking for? The modern associationists like Watson (1919), and later Hull (1943), assumed this basic unit to be a stimulus-response bond. For Lashley (1950, 1963) it was the engram: This engram was supposed to be the basic unit of learning, and memory, just as the atom had been the basic unit for molecular physics.

Lashley spent years removing more and more cortical tissue from rats, but he found his rats had to be almost nonfunctioning before they would forget what they had learned. He never found his engram. Was Lashley looking for something too small, or something that would be appropriate to the computer? Perhaps he should have been looking for the story. If the story is the basis of intellectual cohesion, it could be the engram of our species.

From an information-processing view, the story as the engram represents a surprisingly efficient solution to cognition. As Miller (1956) and Simon (1969, 1979) have pointed out, the number of information "bits," or "chunks," we can keep in mind at one time is limited to five or maybe seven. The story as the engram bypasses the limits set on chunk size. One story can contain an enormous load of information "bits" within its framework. Also, since memory storage and retrieval takes time, the story engram allows more information to be processed and retrieved per unit of time.

Story engrams can vary with respect to difficulty and/or complexity. However, the essential components of the story engram are someone(s) or something(s) (a noun) acting or being acted on (a verb). The appropriate adjectives, adverbs, and other aspects of language function as the conceptual elaborations. The neural encoding of the essential components would represent the units of learning and memory that make up the engram that Lashley described.

If psychology was *looking* for something "too small" when it was searching for the basic unit of learning and memory, did IQ tests and education fall into the same error: test for and teach segments of information that are too small? The assumption that the rote learning of small segments is easier and earlier in child development, as opposed to in-context learning of larger and therefore more abstract units, should have precluded the success of severely retarded subjects (cf. Fuller, 1977). Instead, these subjects succeeded with "code approximation," when they had previously failed in spite of years of teaching with the latest in segmental and rote approaches. Was our success the result of inadvertently having taught with a technique involving the engram of the human species? If so, it would explain why the IQ tests had failed in predicting and describing the success of our severely retarded subjects.

The Story Engram, Emotions, and the CNS

Teachers and therapists have long known that by making a story out of an event or a relationship we gain in its understanding. But something more happens. The storymaking process gives the event or relationship a heightened reality. It raises them into consciousness; they become "real." With the consciousness of this reality which we ourselves seem to create, we come into being. It is our "cogito, ergo sum" or, if you will: "In the beginning was the word, the logo."

For the story is more than a cognitive unit. It is the extension of our emotional selves with an extraordinary capacity to elicit every emotion known to our species. In turn, our emotional states, whether we are irritated, happy, angry, or sad, determine the kind of stories that appear in our consciousness (Bower, 1981). When angry, we remember the awful things that have been done to us. In a more positive mood we tend to forget negative happenings, the same happenings that had made us a seething cauldron when in the angry state. During adolescence our preoccupation with love objects can be truly amazing as our biology seems determined to channel our thinking.

This association of emotion and cognition links the richness of our emotional life to the richness of our intellectual capacity. It makes humankind very different from "man the machine," criticized by Neisser (1963) in his review of information processing theory, for lacking the emotional component. In the world of real people we see the emotional shallowness of the character disorder, the sociopath, reflected in a concomitant intellectual naivete. There is a linkage between habitual emotional patterns, Plutchick's (1980) temperament, and patterns of cognition. Bubbly people tell bubbly stories, morose people tell sad stories. This linkage exists because emotional states determine the stories that "come to mind" (Bower, 1981). When an emotional state is habitual, as determined by temperament, stories of a particular category appear more frequently in consciousness.

The linkage between emotions and the stories they elicit raises fascinating possibilities about how memories are stored and retrieved. Different categories of story engrams may be coded according to the emotions they are associated with, and therefore stored and retrieved according to emotional category. Our experiences of joy would have one type of coding, those of hate or envy, another. Stories with mixed emotions would have double, triple or multiple encodings.

Because a particular story can involve many different areas of the brain, i.e., visual, auditory, kinesthetic, spatial, as well as being associated with a number of emotions, it can leave ubiquitous memory traces. Such over-representation of story memories may explain the apparent equipotentiality, the mass action of the CNS, that puzzled Lashley (1950, 1963). It would also explain why "cutting the pathway which connects the cortex with subcortical structures produces as severe a disturbance as does removal of the cortical tissue itself" (Pribram, Blehert, & Spinelli, 1966, p. 358).

The recent findings concerning the action of neurotransmitters,[4] some of which are associated with emotional states, suggest that these may be involved in the emotional encoding of the engrams. Such emotional encoding would explain why tranquilizers or psychoomimetic drugs manipulate us into producing the memories and ideas that are appropriate to the neurotransmitter, but not necessarily to the real world. Administrators of mental health institutions are very aware that chemical manipulation can be analogous to thought manipulation.

What I am suggesting is a double encoding of the story engram, first on the basis of grammatical structure, and second on the basis of emotional category. Such double encoding would allow for an enormous number of information bits to be stored and expeditiously and appropriately retrieved. At the same time, learning, that is, experience, would be multiply encoded and therefore not easily lost to forgetting or even brain injury. It would explain why "it seems to make little difference to overall performance which part of the system is destroyed and which part remains. . . .the stored information necessary to making a discrimination is paralleled, reduplicated over many locations" (Pribram, 1971, p. 123).

However, emotional encoding of memory has its drawbacks. Because our emotional states determine the kind of stories that appear in our consciousness, thereby influencing our perception of reality, our rationality can be more apparent than real. The paranoid produces coherent stories. But the biochemistry of the disease (Potkin, Karoum, Chuang, Cannon-Spoor, Phil-

[4]Two interesting reviews: Kolata, G.B. New drugs and the brain. *Science*, 1979, *205*, 774-776; Snyder, S.H. Brain peptides as Neurotransmitters. *Science*, 1980, *209*, 976-983.

lips, and Wyatt, 1979) manipulates emotions so that the stories the paranoid believes do not fit reality. Even presumed sane members of our species go to war, kill each other, and think up ways to use our magnificent sciences for destruction. If the stories that appear in our consciousness are internally coherent we often flatter ourselves into an illusion of their rationality, when the results belie their "sanity."

Yet, humankind has battled for rationality. We have developed laws and taboos which, regardless of how we feel, regardless of emotional state, we are not supposed to break. For those who need help with reality there are our therapies. It is interesting to note that in analysis the patient recounts the incidents, the stories, that made up his/her life. These stories, because they now involve consciousness, are expected to lead to an understanding of the causes of behavior. There are also our religions with their magnificent stories which seek to arouse appropriate emotional responses, thereby modifying our actions.

But history records the failure of these attempts to insure rationality. Almost in desperation we have produced engergizers and tranquilizers with which we try to manipulate our thoughts and actions. Even Ghandi, in an attempt to overcome the curse of our evolution, took the tranquilizer Rawolfia so he could practice the pacifism he preached. We have tried, at times valiantly, to gain the ultimate prize — "freedom of will."

Although we can alter the fabric of a story, its emotional category remains the same. Not so long ago our species used clubs, and then swords, as weapons; now we use atom bombs, and tomorrow it may be lasers. The story fabric has altered astonishingly in the last 500 years. However, a war story is still a war story. The emotional category has not changed — even if its fabric has. The more technological the civilization, the more technological the story fabric. But its emotional category, anger, hate, love or envy, and perhaps how it is stored and retrieved from the nervous system, may be the same as at the dawn of our history. And so in the age of space exploration we design weapons that are appropriate to the emotions of our ancestors, making Freud's (1959) description of the corruption of the superego by the id seem very real. However, even if we are still as savage as our ancestors, the stories that elicit the ancestral emotions can be pure 20th century.

Emotions not only determine the kind of stories that "come to mind"; the reverse is also true. There is a feedback loop (albeit an incomplete one) between emotions and stories. Not only do emotions elicit the appropriate story memory, but stories in turn can alter our emotional state. The feedback loop is evident to anyone who has seen a mob incited into action. Words can elicit an emotional state, and words create the human story. But the power of words (as those of us who use them know) has its constraints. There are limits to how far we can be manipulated by even the most moving story. The story of eternal salvation and/or damnation does not prevent its believers from thoughts (stories) and behavior (the acting out of stories) that should lead to their eternal perdition.

Evolution and the Story Engram

These limits to the power of the story appear as evidence for the overriding strength of our emotional programming. Is, in the final analysis, our behavior as inevitably determined as that of the insect? Schneirla (Maier & Schneirla, 1935) suggested that the behavior of insects is mediated on a segmental level, appropriate to an Aristotilian, Cartesion or S-R model. However, the behavior of mammals may be equally determined with an emotional programming which elicits the necessary memories. These memories, because they are created through experience, have the advantage of being coherent with a changing environment. In this way the *individual* mammal has greater flexibility and adaptability in a changing environment than does the individual insect. However, by being programmed emotionally, we may be just as locked into a long-range course of action as is the insect —even though the stories we create give us the illusion of freedom.

At what stage in mammalian evolution did story cohesion develop? Is it unique to humankind, or does it have its antecedence, as so much of our behavior, with the other species of the animal world? The games of catch and fetch and even hide-go-seek that we play with our dogs — are these not a nonverbal story?

As far as words are concerned, many of our fellow mammals understand isolated words. The vocabulary of an intelligent dog may involve dozens of words. However, the games of make-believe that we play with our dogs are primarily nonverbal. They take the form of a charade-story.

But are the apes different? In recent years, several psychologists, for example, Patterson (Patterson and Linden, 1981), the Gardeners (1978), and Fouts (1972), have taught their apes American Sign Language. These investigators report that their apes not only sign several hundred words, but are able to communicate in sentences. The last contention has been questioned by Terrace (Terrace, Petitto, Sanders, and Bever, 1979). But even if the apes are not producing spontaneous sentences, their vocabularies are much larger than those of most of our mentally retarded subjects who learned to read stories. Having met Koko, Dr. Patterson's gorilla, I found her much more verbally communicative than many of our patients, before these patients learned to read with comprehension. This fact raises some fascinating possibilities.

Would the apes be capable of understanding a verbal story? Would they be able to answer questions about the story? Might they even tell a story on their own? And would their vocabulary, like that of the two-year-old child, suddenly explode?

And then there are the dolphins, with a brain that is larger than ours. Are the dolphins the storytellers, the poets, of the deep? Are the convolutions in the cortex of their brain and ours the result of stories and storytelling? If the language structure of the dolphins and whales is based on nouns, verbs, and adjectives, the building blocks of a story, we could, with the use of modern technology, develop a dolphin or whale dictionary.

I do not know what the outcome of these experiments would be. But how fascinating and experimentally important to see if we are the only species that comprehends and learns through story cohesion.

Further, the experiments with apes and cetaceans might give us insight into the development of language structure — the components of the story engram. It is intriguing to note that the nouns and verbs our dogs learn so readily are often the same as those first learned by the child. Is a child's learning of language a recapitulation of phylogeny? Do animals first have a particular sound for certain nouns, like those recently described for wild monkeys (Seyfarth, Cheney, and Marler, 1980)? Is the evolutionary elaboration from nouns to verbs, then from adjectives to adverbs, the same as we see in the child (Gesell, Halverson, Thompson, Ilg, Castner, Ames, and Amatruda, 1940; Piaget, 1959)?

And further, are those first nouns and verbs an elaboration of the emotional sounds common to most animal species? These vocalizations, as Morton's sound analyses show (1977), are surprisingly uniform throughout the animal kingdom. As Zajonc (1980, p. 170) pointed out, "Before we evolved language and our cognitive capacities, which are so deeply dependent on language, it was the affective system alone upon which the organism relied for its adaptation . . . affect can be communicated much more efficiently and accurately than thought in spite of the fact that its vocabulary is quite limited." If language is an elaboration of the emotional sounds of our prehuman ancestors, this would give an ontological explanation for the primary storage and retrieval of story engrams according to the emotions they are associated with.

Yet, it is precisely because stories do give meaning to factual content, that they are so important. We use them to understand ourselves and our universe. If there existed a place in the cosmos where intelligent life did not tell stories, would we be able to communicate with such storyless creatures? What would we talk about? How could we relate to these beings, not only emotionally, but intellectually? Would such creatures seem as mindless to us as our machines and our insects? Because for us, a mind without a story is a mind without meaning. And meaning is the essence of our consciousness. Our story-engrossed brain seems to believe that, in Cartesian fashion, we exist because we tell the story of our existence.

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