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Emergence of the Mediated Mind

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3. Evolution and Development of the Hybrid Mind

In contrast to the evolutionary perspectives found in Chapter 2, which focused on general processes and levels of intelligence and knowing, and on the specific domain of language, Merlin Donald's (1991) proposal for the evolution of the modern mind provides a detailed model of representational stages in evolution that provoke developmental analogies. In this chapter that model and its developmental implications are considered in some detail.' The purpose of using this model of the evolution of human cognition for a developmental analysis is to provide an integrated conceptualization of the biological in human cognitive development that coheres with (and does not compete with) the cultural. Donald's scheme is an attempt to do this on the phylogenetic scale. As forecast in the previous chapter, the biology of the human individual is seen as potentiating the cultural achievements of the group, thereby making possible the more complex cognitive achievements of individuals within the group. There is no possibility of divorcing biology from culture in this scheme. Similarly, there is no possibility of divorcing the mind from the body, or ideation from activity.

Donald's Theory of the Evolution of Human Cognition and Language

The goal of Donald's (1991) original theory of the phylogenetic evolution of human cognition is to find a satisfactory solution to the problem of how human cognition evolved over a brief period of time (speaking paleontologically) from a basic general primate structure to the far more complex and differentiated - and thus powerful - human kind. He notes at the outset what is often overlooked in our enthusiasm for seeing parallels, analogies, and beginnings in earlier forms: "Despite our close genetic relationship to apes, the cognitive distance from apes to humans

is extraordinarily great, much greater than might be imagined from comparative anatomy" (p. 3). Then:

> The essence of my hypothesis is that the modern human mind evolved from the primate mind through a series of major adaptations, each of which led to the emergence of a new representational system. Each successive new representational system has remained intact within our current mental architecture, so that the modern mind is a mosaic structure of cognitive vestiges from earlier stages of human emergence. (pp. 2—3)

These vestiges are supplemented by new symbolic devices that have radically altered the organization of the human mind. In essence, Donald attempts to provide the "conceptual framework within which our continuing mental evolution may be viewed" (p. 4). His claims are grounded in the literature on primate and early human physical and cultural evolution reviewed in the previous chapter. Although the ideas expressed are admittedly speculative, they are necessarily so by the nature of the evidence. What follows is a summary of the main theses of Donald's proposals as a background to the developmental implications suggested by them, which are considered in the latter part of the chapter.

Stages in the Evolution of the Modern Human Mind

Donald's conception is that culture and cognition are mutually constitutive, and in his theory the major stages of the evolution of mind are defined in terms of cultures, with cognitive (and biological) characteristics derivative therefrom. Note that this use of "culture" is essentially synonymous with "human (or primate) environment," without necessarily implying artifacts, activities, or practices typical of human societies. The emphasis is the same as that expressed in the previous chapter — that organism and environment are mutually defined.

Episodic Culture — the General Primate Mind

What kind of representational intelligence might we ascribe to the ape mind? As we saw in the last chapter, comparative research has documented considerable commonality between the cognitive abilities of apes and humans in infancy. Moreover, much recent work has been devoted to exploring the extent to which some apes (mainly chimpanzees) may be taught to use symbol systems of varying kinds (e.g., American Sign Language, computer icons). Although there are conflicting conclusions on this issue, there seems to be little doubt that apes can learn to associate a large number of symbols (in the low hundreds) with objects, events, people, and relations, and can use them in their interactions with humans to express desires and intentions, up to the level approximately of the 2-year-old child (Savage-Rumbaugh et al., 1993). However, no primates except humans have ever invented symbols. It is Donald's contention that the "episodic culture" of the primate mind did not provide the basis for such an invention.[2]

Donald elaborates this argument as follows: "The episode is the 'atom' of ape experience, and event perception is the building-block of episodic culture" (p. 153). This statement highlights important differences from the classic conception of objects as the units of "basic cognition." "Event perception is, broadly speaking, the ability to perceive complex, usually moving, clusters and patterns of stimuli as a unit" (p. 153). Furthermore: "Animals that we call intelligent are those that respond to events of increasing complexity and abstraction" (p. 154). The simplest events are "close to" object perception. In other words, event perception incorporates more complexity than object perception (which is customarily taken to be the "basic building block" or "atom" of human — and presumably primate — cognition). Object cognition is simply a special case of event cognition — slowed down to a stop, as it were.[3] This position is consistent with the emphasis on events in Gibsonian ecological perception (J. J. Gibson 1979; Shaw & Hazelett, 1986) as well as the event knowledge perspective set forth in Nelson (1986; Nelson & Gruendel, 1981), outlined in Chapter 1.

Ape behavior is nonetheless unreflective, concrete, and situation-bound. "Their lives are lived entirely in the present, as a series of concrete episodes, and the highest element in their system of memory representation seems to be at the level of event representation" (p. 149). Episodic memory consists of the "specifics of an experience: the place, the weather, the colors and smells, . . . such memories are rich in specific perceptual content. By definition, episodes are bound in time and space to specific dates and places" (p. 150). Donald contrasts this type of memory with human semantic memory [following Tulving (1983)], that is decontexted from time and place. He concludes: "From a human viewpoint, the limitations of episodic culture are in the realm of representation. Animals excel at situational analysis and recall but cannot re-present a situation to reflect on it, either individually or collectively" (p. 160). In contrast, "The cognitive evolution of human culture is, on one level, largely the story of the development of various semantic representational systems." What he

emphasizes with respect to memory differences in ape and human is that episodic memory in apes enables the storage of situational information, but that its recall depends upon environmental triggers, whereas in humans recall is under voluntary control.[4]

It is important to distinguish "event memory" from what has been commonly termed "procedural memory" (Sherry & Schacter, 1987). Procedural memory retains procedures for carrying out actions and is usually considered to be shared by most (all?) species of mammals. In some theories procedural memory is characteristic of human infants and is contrasted with declarative memory, which is representational and therefore accessible to recall and reflection (Mandler, 1984a). Donald considers one of the primary distinctions between procedural memory and episodic memory to be level of generality, with procedural storing generalities and episodic storing specifics and not the general. Following Sherry and Schacter (1987), he claims that the two functions are incompatible, and that the same neural mechanism could not do both.[5] The important point — shared here — is that event memory is a form of representation that involves a degree of conscious awareness.

However, the degree of conscious awareness involved in event representation is not, Donald asserts, a sufficient basis for the emergence of language. The limitations of the cognitive capacities of the great apes can be viewed in part in terms of the difference between generating or inventing symbols in contrast to simply acquiring their use. This important point is a key to Donald's theory: "Invention was, of course, the key piece of the puzzle; the first user of specific gestural signs had to be able to invent them *de novo*. And invention is also a key aspect of human language capacity. . . . Language would not have emerged in humans, and probably could not have been sustained, unless each succeeding generation was capable of reinventing it" (p. 134); and, "To proceed from the limited representational capabilities of apes to the next level of symbol use required a qualitative cognitive change, a move towards symbolic invention, with the concomitant cultural change such a capacity would imply" (pp. 136—137). What is the nature of this cognitive change, and when did it emerge? Donald speculates (together with many other recent writers; see Chapter 2):

> Since language is a social device first and foremost, it is logical to expect the growth of language to be tied to the evolution of social structure. As social groups increase in complexity and size, the control and stabilization of group behavior, as well as the sharing of knowledge, becomes important. . . . Whatever forms preverbal social intelligence may take, it is clear that language was the final step, and that presymbolic forms of social intelligence must have been its foundation. (p. 137)

In addition to social intelligence, tied to the complexity of social groups, Donald invokes *self-awareness* as a step beyond simple awareness and even the consciousness associated with episodic memory (see the discussion in Chapters 4 and 10). Self-awareness has been shown to be very limited in nonhuman primates, as demonstrated through experiments with different species concerning self-recognition (Gallup, 1970; Parker, Mitchell, & Boccia, 1994). Human infants achieve this minimal level of self-awareness during their second year.

Mimetic Culture: The Mind of Homo Erectus

Both social intelligence and self-awareness are critical to the transition to the next cognitive/cultural stage posited by Donald. His conception of mimetic culture and its cognitive correlates is his most original proposal. Because the paleontological record of hominid evolution is confined to physical evidence of morphology and cultural artifacts (when these are found), constructing a history of cognition is of necessity a highly speculative enterprise. On the basis of the phylogenetic record of brain growth in successive species of hominids, together with evidence of emerging complex culture, Donald has identified "a category of archaic but distinctly human culture that mediated the transition from ape to human" (p. 162). He terms this culture-cognition form "mimetic" on the basis of what he views as its dominant or governing mode of representation.

What is mimesis? According to Donald, it is a kind of imitative skill, but it is distinct from other types, such as mimicry, which is a literal attempt to produce an exact copy of some behavior, and which some birds are capable of. Imitation is less literal than mimicry and is engaged in to some extent by monkeys and apes[6] — it involves replicating a behavior to perform a similar function, as when offspring imitate the behavior of parents. *Mimesis,* according to Donald, incorporates mimicry and imitation to a higher end, that of *re-enacting and re-presenting* an event or relationship. That is, mimesis is fundamentally representational; it is representation through action. In this respect it is consistent with Piaget's (1962) descriptions of early imitation. Moreover, it involves "the *invention* of intentional representations" (p. 169), and "When there is an audience to interpret the action mimesis also serves the purpose of social communication" (p. 169). However, it is not confined to communication.

One may rehearse and refine a skill, and the act itself may be analyzed, reenacted, and reanalyzed, that is, represented to oneself. This also counts as mimesis.

The important point is that the properties of mimetic acts include "intentionality, generativity, communicativity, reference, autocueing, and the ability to model an unlimited number of objects" (p. 171). This list dovetails neatly with the characteristics associated with human language, and thus may set the stage for the emergence of speech. It is critical that mimesis is both shared — communicative — and individual — cognitive — as is language itself.

Mimetic culture consists of the forerunners of those "significant parts of normal human culture" (p. 167) that function without much involvement of symbolic language. These include trades and crafts, games, athletics, art forms, aspects of theater, and social ritual. Donald's claim is that early social intelligence of *Homo erectus* (1.5 million to 0.3 million years ago) developed forms of social life that involved mimetic skills such as are employed in these cultural forms today. This evolutionary claim is based on "one of the basic principles of evolution . . . the conservation of previous gains in adaptation. The human sensory and motor apparatus has remained essentially similar to those of primates presumably because the primate sensory apparatus continued to serve its purpose perfectly well. Changes in our brain, by contrast, were driven by a different level of selection pressure" (p. 165). Donald adds, "A cognitive culture that was successful in inventing, transmitting and maintaining complex social and technological skills would continue to be useful even after language had been adopted" (p. 165). Thus there is the evidence of cognitive vestiges of *Homo erectus* in athletics, rituals, games, dance, and so on in human life today.

The social consequences of the development of mimetic skills and the emergence of mimetic culture are numerous. Mimesis provides the possibility of modeling social structure or sharing knowledge without the necessity of every group member reinventing it. Thus there may emerge and persist a collective conceptual "model" of society, including its social roles. One sees the corollary in human childhood, where children rehearse and model society, acting out not only their own roles but those of other players. Group play in the "housekeeping corner" of any early childhood center reveals this rehearsal in action, even prior to incorporating language into it [French, Boynton, & Hodges (1991); see Chapter 4]. In addition to such overt modeling, mimesis enables playing reciprocal

mimetic games and group mimetic acts, and evokes conformity and coordination within the group. Mimesis provides the basis for innovation and generativity, as well as nonlinguistic forms of pedagogy. The uses of mimesis in facial expression and vocal expression are special cases particularly relevant to the emergence of speech.

How did mimesis develop? One of the obvious routes is the freeing of hands — following attainment of upright posture — for technological skills, childrearing, toolmaking, gathering and hunting, sharing food and other resources, and constructing and sharing shelter. Mimesis is not confined to the hands, however; essentially it involves the integration of motor modalities, and in this integration the use of rhythm is critical.

Like language, mimesis as a representational system has two sides. Its social side is seen in its use in the control and coordination of *social* activities. But as an individual *cognitive* system of representation, it goes beyond the event representation possibilities of the primate system. Now the individual's own body, and its representational movements through space, can be re-represented in the brain, providing "a conscious map of the body and its patterns of action in an objective event space" (p. 189). Donald speculates that the parsing of event sets is central to what he calls the "mimetic controller." This level of representation is capable of "integrating models of self and the external world and expressing these relations through the movement systems" (p. 193). The potential of this level has much in common with Karmiloff-Smith's (1986a, 1992) first level of "explicitation" (summarized in Chapter 1). Table 3.1, based on Donald's table 6.1 (p. 198), summarizes the skills, social consequences, and cultural potential and achievements of this period of human evolution.

Readers may identify a missing piece between this description and the next stage — the piece that is customarily identified with the beginning of language, namely the first production of speech sounds in the form of words or speech symbols, which it might seem natural to attribute to the early *Homo sapiens* in this mimetic cultural milieu. Despite the strong intuition that early language must have begun with single word-like productions (as does early child language), there is no available evidence on this point. Mimesis as a symbolic system and single words are not necessarily competitive but may have been convergent or coordinated. Indeed, the physical evidence (Lieberman, 1984; Studdert-Kennedy, 1991) strongly suggests that vocal productions must have been part of this evolutionary period of development.

Table 3.1. *Elements of an archaic hominid mimetic adaptation*

Episodic Culture Primates	
+ Mimetic Skill	Intentional representations
	Generative, recursive capacity for mime
	Voluntary, public communicative system
	Differentiation of reference Unlimited modeling of episodic events
	Voluntary autocued rehearsal
+ Social Consequences	Shared modeling of social customs and hierarchies
	Reciprocal mimetic games Enhanced conformity and coordination
	Group mimetic acts
	Slow-paced innovative capacity
	Simple pedagogy and social attribution
= Mimetic Culture	Toolmaking, eventual fire use
	Coordinated seasonal hunting Rapid adaptation to climate, ecology
	Intricate social structure
	Primitive ritual (group mimetic acts)

Source: Donald (1991, p. 198). Reprinted by permission of the publisher from *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition* by Merlin Donald, Cambridge, MA: Harvard University Press. Copyright ©1991 by the President and Fellows of Harvard College.

Mythic Culture: Stone Age Homo Sapiens

A major cultural change can be observed beginning around *35,000 B.C.*, when the Upper Paleolithic *Homo sapiens* are contrasted with *Homo erectus* and primitive *sapiens.* Among the Stone Age peoples are found the characteristics of all true human cultures: the manufacture of clothing, fabric, sewing, transporting heavy objects, constructed shelters, implements, and weapons. There is also evidence of knowledge about the growth, selection, and preparation of food; use of fire; and navigational skill. Complex social and religious life is found, including dance, chants, masks, costumes, self-decoration, and semiotic devices to indicate clan, status, and totemic identification. This rapid proliferation of cultural achievements calls out for explanation, and the contemporaneous emergence of complex language must have played some role therein.

Donald has two important claims to make with respect to the emergence of human language. The first is that mimetic culture was a necessary precursor and foundation; the second, and relatedly, is that "Above all, language was a public, collective invention" (p. 216). In this view, language was invented to serve social purposes (see also note 18 in Chapter *2* for Konner's 1982 description of talk among the !Kung). Even more important, the essential functions served by language according to this theory were integrative and thematic, supplying a unifying synthesis to formerly disconnected time-bound snippets of information. This observation is highly relevant to the developmental story told in the subsequent chapters of this volume.

Donald's claim is, "The most elevated use of language in tribal societies is in the area of mythic invention — in the construction of conceptual 'models' of the human universe" (p. *213).* Myth attempts to explain, predict, and control, going beyond the mere representation potentials of mimetic culture. Myth is integrative, deriving general principles and extracting thematic content. The claim, then, is that the "natural product" of language is narrative. According to this claim, language did not emerge primarily to name things but to integrate models of the world. Language adaptation was not simply a matter of the emergence of symbols or grammars.

> Possession of symbols alone . . . would change nothing. It is the representational intelligence underlying the symbol that defines its power and leads to its invention. It is thus the nascent mental model that cries out for the perfect symbol . . . to express its as-yet-uncaptured concept. . . . Symbols could not have come first and triggered language and thought by their invention. The invention of symbols, including words, must have *followed* an advance in thought skills, and was an integral part of the evolution of model building." (p. 218)

This is a strong, original, and provocative thesis. It has serious implications for how we think of human development.7.' The central importance of this claim is clarified in Donald's observation that

> Episodic minds (as in apes) can use symbols when provided with them, and mimetic minds employ symbolic mimetic displays; each uses symbols in its own way. Modern humans, similarly, use symbols in our own way. The value of a symbol depends on the kind of mind putting it to use. Episodic minds create episodic models of the world, mimetic minds create mimetic models. Signs and symbols, given to such minds, possess no magical powers to change this. By extension, modern minds create the kinds of symbols that they do because their thought processes are different." (p. *225)*

Modeling is a key concept in Donald's theory about the evolution of language: "Thought and language are so closely related as to be two sides of the same coin; there are many forms of thought that are literally unthinkable without language and other semiotic devices. Most importantly, where humans differ from apes and other mammals is not so much in their possession of signs and symbols but in the types of mental models they construct" (p. *233)*.

Donald's construction of the emergence of language is based on the paleontological evidence [following Lieberman's (1984) reconstruction]. However, he departs from the usual story in his conception of the functions and products of language, as well as in his conception of the cognitive basis for the language adaptation.

First, the emphasis is placed squarely on speech as a semiotic device that was necessarily prior to any derivative form (e.g., sign language, written script, etc.). Note that the mimetic cognitive system incorporated primitive semiosis. The addition of the speech system built on this base and enabled the human symbolic capacity to move beyond it to develop complex language dependent on high-speed processing capacities. The function of language as a discourse mechanism, integrating thought over extended thematic passages, stands in contrast to the idea of language as a device for categorizing objects of the world. Of course, it is necessary to construct discourse from parts (phonemes, words, sentences) and to analyze it in terms of parts in order to recover meaning. And it is necessary to invoke categorizing skills for each of these processes. However, the primary function of language, in Donald's view, is integrative. It is this function that drives the selection pressure toward a high-speed system requiring additional memory capacities as well as rapid production and analytic devices.

Language brings mental models under symbolic control. "Different kinds of models, in which the event structure of the world has been differentiated and the components made independently accessible in memory" (p. *252)* become possible. This representational function of language is critically important to the developmental story. It is because the models constructed through language encompass words used in their definition and that words are an integral part of the definition of the model that the parts can be independently manipulated and entered into new constructions never before experienced in the world. Mental models thereby move beyond human experience into new possible worlds. This claim for the potentiality of language beyond that of prior human cognition is implicit in much thinking about the relation of thought and language, but making it explicit provides a clearer perspective on the function of complex language forms. Donald goes further:

> Once the mind starts to construct a verbally encoded mental "world" of its own, the products of this operation – thoughts and words – cannot be dissociated from one another. . . . The models and their words are so closely intertwined that, in the absence of words, the whole system simply shuts down. There is no surviving "language of thought" from which the words have become disconnected. No symbols, no symbolic thought, no complex symbolic models. (p. *253)*

The implications of this claim for contemporary models of cognitive science (e.g., Fodor, 1975, *1983;* Newell, 1980) and for developmental psychology appear to be enormous. Among others, the claim implies that the language "center" in the brain does not in itself contain symbols independent of the language learned in ontogeny. Symbols come from outside the individual, from the group, although the potential for acquiring, using, and inventing symbols is part of the human cognitive (brain) system.

As stated earlier, Donald sees narrative as "the natural product of language." Narrative evolved from mimetic culture and drove the evolution of language: "Narrative skill is the basic driving force behind language use, particularly speech: the ability to describe and define events and objects lies at the heart of language acquisition. Group narrative skills lead to a collective version of reality; the narrative is almost always public" (p. *257)*. This statement incorporates the central themes of Donald's thesis. Language is public, a human invention for the purpose of integrating thematic constructions of events. Stories, histories, memories are enshrined in narrative to be shared with others.

Myth is a major product of narrative; therefore, this linguistically defined cultural epoch is termed "mythic." Myth represents the authoritative version of reality for the group; it is a filtered product of generations of narrative interchange. When mythic narratives became possible they complemented the mimetic representations already existing in ritual, song, dance, and games, and took over a controlling role in these group representations. Through narrative the group could share in a common understanding that existed through time as well as across individuals within the group; it could be passed on from generation to generation. The mythic culture enshrines a shared vision of both past and future that does not simply reconstruct human experiences but attempts to explain them in more encompassing terms.

By the end of the Paleolithic epoch, language was fully evolved and mythic culture fully ensconsed, as it is in hunting and gathering cultures in the contemporary world. As noted in Chapter 2, from every indication that we have, biological evolution of the human species was complete at the time that language and myth arose (35,000 years ago). Donald concludes: "The human mind had come full circle, starting as the concrete, environmentally bound representational apparatus of episodic culture and eventually becoming a device capable of imposing an interpretation of the world from above, that is, from its collective, shared, mythic creations" (p. 268).

What could be next? What is the alternative to narrative as the primary product of language? Bruner (1986) has contrasted "narrative thinking" with "paradigmatic thinking," the prototype of which is analytic thought, based on logical categorical construction, construction that is abstracted from events in the world. Although much discussion in both cognitive science and cognitive development appears to assume that paradigmatic thinking is the premier function of language, Donald sees such a function as waiting for the next stage of development, theoretic thinking.

Theoretic Culture: Modern Human Mind

Donald's final radical proposal about the evolution of human thought, memory, and representational systems is that further cognitive change was a product not of biological change but of cultural invention. He notes first that three "crucial cognitive phenomena" were underdeveloped or nonexistent in mythic (oral) culture: graphic invention, external memory, and theory construction. The major products of analytic thought, including formal arguments, systematic taxonomies, formal measurement, and logics, were generally absent. The transition to the next stage culminated in formal theories. Whereas the myth integrates and typifies, the formal theory is an integrative device that predicts and explains. This third transition in human cognitive evolution was not biologically supported — biological evolution was complete in the previous stage — but was dependent on technological evolution, and specifically on the development of external memory devices. Among the first and most important of these were forms of written language, usually thought of as communicative rather than memory devices.

The first externalization from the human body was the visuographic representation in pictorial form, evident in the great detail found in cave paintings. This observation implies that external representation through (oral) language preceded external iconic representation. A second much later move was the ideographic representation, which began as a kind of pictorial narrative (as in the Egyptian tombs) and evolved into a representation of lexical concepts. Note, however, that this original visuographic representation denoted concepts directly, and not through the speech system. These were in effect, alternative language systems.[8] The invention of the phonetically based alphabet in the first millennium B.C. was the first attempt to translate speech/language directly into written form.

These external representations — and especially the last — then served as a kind of "external memory field" (EXMF) through which events could be interpreted. With the possibilities opened up through written script, the long-term storage of speech-based language became a source of shared knowledge systems that could be maintained over time in the same form, thus less dependent upon interpretive shifts in conceptual systems.[9]

External symbolic storage (ESS) systems include books, libraries, and records of all kinds. Both science and art depend upon external memory devices involving such storage systems as musical notation, maps, and geometry. The primary characteristic of this advance is that the system is external to the biological representation or memory of any given individual. But the individual functions within the culture only with the assistance of such systems. Thus memory can no longer be thought of as having clear biological boundaries, as psychology traditionally assumes. According to Donald, external memory "is the *exact* external analog of internal, or biological memory, namely a storage and retrieval system that allows humans to accumulate experience and knowledge" (p. 309).

> The memory system, once collectivized into the external symbolic storage system, becomes virtually unlimited in capacity and much more robust and precise. Thought moves from the relatively informal narrative ramblings of the isolated mind to the collective arena, and ideas thus accumulate over the centuries until they acquire the precision of continuously refined exterior devices, of which the prime example is modern science. (p. 311)

Donald views ESS as being encoded in terms of "exograms" in analogy with the traditional "engram" of memory studies. The similarities and differences between the two are outlined in Table 3.2 [from Donald (1991), table 8.1, p. 315]. As is evident from this table, Donald sees the invention of external means of information storage as providing almost unlimited potential for human cognition. As long as cognition is conceived to consist of operations on information represented in memory

Table 3.2. *Some properties of engrams and exograms*

Engrams	Exograms
Internal memory record	External memory record
Fixed physical medium	Virtually unlimited media
Constrained format	Unconstrained and reformattable
Impermanent	May be permanent
Large but limited capacity	Virtually unlimited
Limited size of single entries	Virtually unlimited
Not easily refined	Unlimited iterative refinement
Retrieval paths constrained	Retrieval paths unconstrained
Limited perceptual access in audition, virtually none in vision	Unlimited perceptual access, especially in vision; spatial structure useful as an organizational device

Source: Donald (1991, p. 315). Reprinted by permission of the publisher from *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition* by Merlin Donald, Cambridge, MA: Harvard University Press. Copyright ©1991 by the President and Fellows of Harvard College.

(and no alternative to this conception seems available), then it follows naturally that the enormous increase in potential that ESS systems have made possible must be the source of the enormous advances in cognitive achievements of the historical period.

It must be emphasized, however, that both engrams and exograms are interpretable only by the human mind; the latter were indeed invented for interpretability. Only the individual human can provide a referential basis for understanding the memory record, whether it is a biological or an external record. The properties of exograms listed in Table 3.2 emphasize the open-ended, relatively unconstrained and unlimited capacity available through ESS systems, which are, of course, continuously being reinvented and refined, thus continuously adding to the already available potential.[10] Cognitive scientists often cite with awe the extraordinary potential of the human neural networks; Donald's point — seemingly obvious yet scarcely noted by most cognitive psychologists — is that this potential is vastly augmented and amplified by the external systems that humans have come to rely on in carrying out cognitive processes. For example, most human memory operations do not rely on biological storage alone, but on the accessibility to the biological system of technological forms of storage. Yet studies of unaided memory in the psychological laboratory do not tap into this system, and thus present a very limited picture of human cognitive potentials.

Formal education systems have been designed primarily to teach skills for using ESS systems, beginning with reading, writing, and arithmetic. Beyond these basics, students are taught how to *manage* the joint biological/technological memory system, to acquire knowledge in a domain in an organized form such that the two parts can be used effectively in tasks requiring that knowledge. Sometimes the biologically stored knowledge will be sufficient to the task, but often input from an external source (e.g., reference books) will be needed to supplement. In any complex cognitive task external tools — written notes, equations, diagrams — will serve as temporary memory stores for the working out of problems and implications. Thus ESS systems serve as both short-term and long-term memory amplifiers; each serves a vital purpose in modern human cognition. Biological memory becomes the loop in the thought process that performs transformations and analyses on the data base provided by external symbols. "External symbolic stimuli not only drive the thought process; they serve as the brain's holding tank while its various systems go about the business of processing and altering the symbolic environment" (p. 332).

The culture that has emerged in conjunction with the invention of the succession of more and more powerful technological systems is termed by Donald "theoretic culture." Biological memory "could not possibly have supported the type of theoretic development that humans have come through during the past four millennia. Working memory is too transient, too vulnerable to distraction, and too limited in capacity to manage a major cognitive project that may eventually result in theoretic products. . . . This symbiosis of human working memory and the [external memory field] is basic to modern thought" (p. 331).

Donald's claim is not simply that the human mind in its reflective mode felt the need to invent external systems to aid that reflection; rather, the invention of such systems made possible a new kind of cognitive stance of reflection, and thus enabled new possibilities of modification and refinement. This process led eventually to systems of logic, mathematics, philosophy, and science. For example, "Logic evolved out of an external, formalized process of verifying the 'truth' of propositions. The 'rules' of logic are themselves a working model of the verification process. The development and acquisition of purely symbolic — that is, logical — verification has a long and arduous history of symbolic invention; it was the furthest possible thing from an innate process" (p. 353). Moreover, "No major graphemic products — things such as novels, scientific theories, economic forecasts – have an equivalent in purely oral

expression. They are products of hybrid minds with extensive ESS linkages" (p. *354).*

Not everyone who has compared oral and literate cultures would agree with these statements, but it is important to recognize that Donald's claims refer not to thought processes per se but to the power that results from complementing basic human cognition with external and shareable representations." He sees in this development radical cognitive change resulting, not from biological evolution, but from the cultural evolution that the biological potential for generativity – invention –of symbolic forms made possible. The conclusion to this story follows:

> Our modern minds are thus hybridizations, highly plastic combinations of all the previous elements in human cognitive evolution, permuted, combined, and recombined. Now we are mythic, now we are theoretic, and now we harken back to the episodic roots of experience, examining and restructuring the actual episodic memories of events by means of cinematic magic. And at times we slip into the personae of our old narrative selves, pretending that nothing has changed. But everything has changed. (p. *355)*

Developmental Parallels and Implications of the Evolution of the Hybrid Mind

Donald's cognitive evolution proposal posits representational change as the fundamental advance from primate to human cognition, eventuating in the modern hybrid mind. The proposed stages in human evolution imply the possibility of a developmental parallel. The idea that the hybrid modern adult mind contains episodic, mimetic, oral narrative, and theoretic representations altogether suggests that modes of cognition may emerge at different times and in different combinations in the course of human development. If this is so (and, of course, it remains to be shown) it would have important implications, not only for develop-mental theory but also for, among other things, educational practice. Such a possibility certainly seems worth examining. To recapitulate briefly, the following themes are basic to the proposal, and they each suggest developmental implications.

- *Emphasis on event memory as basic in the primate line.* This proposal suggests that a similar level of representation would be found at the earliest stages of human development, as well as throughout life, although the dominance of event memory would be expected only in the first stage.
- *Emphasis on the dynamic relation between cognition, cognitive potential, and the culture within which it operates, especially in its social functions.* This emphasis clearly suggests that a developmental theory ought to include as a significant component the cultural milieu of the individual, and to the extent that the relevant aspects of culture vary, concomitant variations in cognitive functioning would be expected.
- *Emphasis on model building as a driving mechanism in cognitive advance.* Here one would expect a theory to specify the content and structure of cognitive models as they change with development.
- *Emphasis on layers of representation in the developed hybrid mind.* Rather than focusing on one kind of representation (scripts or theories, for example), a theory should take into account that information may be processed and represented in different ways for different purposes, and in more than one way simultaneously.
- *Emphasis on the role of language in cognition.* A theory ought to be explicit in spelling out how language enters into cognitive processing and representation, and how language changes cognition.
- *Emphasis on external support systems, such as written materials, for complex cognitive processing and representation.* One would not expect nonliterate children or adults to perform at the same level of complex cognitive operations as literate people. In particular, one would not expect theoretical systems to emerge without external symbol systems. And, one would not expect individuals of any age to perform at the same level of complexity without external aids as they could perform with such aids.

A developmental analog of the evolutionary scheme might present the following view: The human child is first seen as growing within a social/collective community that provides a rich array of semiotic meanings that the child encounters "naturally" in the course of growing older. Second, the child is seen as moving through a series of representational potentials, beginning with the simple acquisition of event knowledge, which implies a dynamic functional system at base, and developing mimetic forms of representation. Third, the revolutionary impact of language representation on the more primitive systems is revealed, both in the "natural" narrative form and in the fully developed abstractions of the theoretical forms. In addition, the impact of all the cultural technology of external support systems is recognized, together with the implications of these supports for the later stages of cognitive development. Finally, the open-endedness of the human cognitive system is brought into full focus. The telos of modern mind can be recognized as a moving target, now amplified by technology but open to further possibilities as technology advances. At the same time, the constraints on the biological potential of the human cognitive system bring into focus the limitations of any individual within the collective culture. The human mind today is as much a product of its culture as – and perhaps more so than – it ever was in the past. Before proceeding

with this version of the developmental story, some limitations on the analogy must be noted.

Phylogenetic and Ontogenetic Analogies: Cautionary Considerations

Biologists (Haeckel, 1905) and psychologists (e.g., Hall, 1904) of the nineteenth and early twentieth centuries found the parallel between evolutionary progression and ontogenetic development to be compelling (Cairns, 1983; Gould, 1977). Since then, in both biology and psychology, this parallel – incorporated in the familiar aphorism "ontogeny recapitulates phylogeny" – has been discarded for good reasons (Gottlieb, 1992). Yet the claim of an evolutionary progression in cognitive power in the human line compels an examination of the evidence for the survival of vestiges of the earlier forms – especially given Donald's claim of the hybrid adult mind, which retains aspects of four representational systems – and requires confronting the hypothesis that earlier stages of human thought might be more clearly visible in the earlier stages of human ontogeny. Of course, any developmental analog of an evolutionary model must take into account certain well-understood cautions about drawing lessons for ontogeny from phylogeny.[12]

Child in Culture. The first cautionary note is that, unlike the development of earlier hominid species and early *Homo sapiens,* modern human development takes place within a modern cultural milieu (assuming the contemporary culture of the developed and developing world). Donald's thesis is that cognition and culture are mutually definable and dynamically interdependent. But the contemporary human infant is not born into a culture that is first episodic, then mimetic, then mythic, and finally theoretic, as the phylogenetic proposal implies. Indeed, modern educated parents confront their progeny from the beginning with representations from cultural materials of an advanced technological society; books, museums, and computer programs are part of the world of the very young in much of modern society. Could an episodic or even mimetic mind adapt to a theoretic culture? How would such adaptation look? Of course, as Donald points out, the adult mind is hybrid, and adult culture is hybrid as well. Thus as the infant mind developed it might adapt selectively to those aspects of adult culture that it could encompass. The important point remains, however, that the modern

complexity of the culture of childhood must become part of the system within which we describe development.

Teleological Development. A second caution must come from the related point that the modern human child develops toward the end point of the modern human with a hybrid mind, including the potential for engaging in the highest forms of human cognition in conjunction with all the external representational apparatus available. This means that the de-vices, both biological and technological, that come to support the most advanced thinking must be developing, coming into existence, and being perfected prior to their final expression in adult thought. The educational process is only one aspect of this part of human childhood. The expectations of parents and other adults that the child will grow into the competent adult must provide a social milieu within which the early cognitive capacities of the child operate that is vastly different from that in which similar capacities might have operated for adults in earlier species and subspecies in the hominid line. In particular, as is explicated in more detail later, learning to speak and understand one's language is prerequisite to its functional use as a representational system, but during the learning period the cognitive system may continue to operate principally in terms of an earlier developmental system. The idea that biological development of the cognitive system is succeeded by and interdependent with cultural development raises the possibility that growth may be a function of different processes at different points in development. At the same time, the underlying self-organizing principle must be operating throughout.

Developmental Chronology. The evolution of human cognition occurred over several million years. Even the most recent stage in Donald's scheme (i.e., writing) has occupied several millennia. The human child, in contrast, progresses from neonate to adult status within about 16 to 20 years. This is not just a compression of the sequence; rather, the question must be asked as to whether the sequence could be the same under both time schemes. To take language again, first words and first pre-tense tend to occur at about the same time in human development. Yet Donald's claim is that in evolutionary time, games, routines, and rituals preceded symbolic speech, and that when speech emerged it served as a vehicle for narrative. Does the developmental evidence bear on the

evo-lutionary hypothesis? Or does the fact of different chronologies implicate different developmental orders? These questions can only be raised at this point, not answered.

Biological Evidence. The cautions articulated above are meant to forestall too easy analogies from phylogeny to ontogeny. In addition, Donald's evolutionary speculations are based on detailed evidence about the increase in cerebral cortex in the hominid line in comparison with other primates, and on evidence of hemispheric specialization and the development of language centers in the left temporal lobe. It might be asked what the theory would predict with respect to the neurological basis for the development of three stages of cognition beyond the basic event representation stage. The following speculations are based on the evidence reviewed in Chapter 2, but given the fast-changing state of studies in developmental neurobiology, they should be taken as purely suggestive.

First, the initial foundation should look and function much as the primate brain does. This condition is well substantiated in the brain-behavior literature (Goldman-Rakic et al., 1983; Diamond, 1993) focused on the development of object concepts and relations. Second, the emergence of a level of imitative, mimetic representation should be signaled by maturation of activity in the frontal (integrative) lobes, following after the maturation of motor areas (which make such mimesis possible). Third, maturation of the language-processing areas should signal the development of early language learning. This should be followed by new activity in the integrative frontal lobes as integrated language representations become possible. The next level of activity should be observed as learning of external symbolic systems (reading, writing, arithmetic) proceeds. This activity should be dispersed to areas eventually devoted to mathematical or written language processing. A final level of activity in the frontal lobes should be observed as integration of ESS systems is developed. With highly educated subjects, further bursts of activity might follow as domains of knowledge became subjected to theoretical systematization and creativity.

This sequence of maturational activity cannot be specifically validated with current data, and it would be desirable to have much more specific hypotheses about what areas should be developing in what ways at what times. At present, however, the data look promising from both brain and behavior directions, and suggest appropriate ages at which to look for the relevant developments, which are consistent with those summarized in the previous chapter.

There is no evidence that any particular brain structure, area, or function subserves any specific mode of representation, aside from the well-established localization of language-processing centers (Broca's and Wernicke's) in the left temporal lobe. Donald suggests that prelinguistic mimetic symbolic processing may have been (and still might be) situated close to the language-processing centers.. The speech and language centers, so far as we know, subserve the *processing* of language — its production and interpretation — not its possible function as a system of content representation or model building. But even the storage of words and word knowledge, thought to be centered in Wernicke's area, is not the same as a center for representing thought in language, as in narratives about events.

It may be speculated that the early developments in brain maturation at 18 to 24 months (activity, synaptogenesis) are symptomatic of the advance in *learning* language and *using* symbolization in general. In contrast, the peak in neural activity at age 4 to 6 years might correlate with the potential to *represent* in language. Another peak at 7 to 8 years might be associated with external symbolic acquisition and development, which becomes consolidated as a representational system at 11 to 12 years, and which might lead to theoretical potential at about age 15 to 16.[13] These peaks in brain development have all been documented in recent work (see Dawson & Fischer, 1994; Johnson, 1993).

Beyond the speculative nature of this discussion, the point is simply that after we leave the rather neat fits between brain and behavior demonstrated for infrahuman primates (which have been shown to map onto human development at somewhat later ages in infancy) there is very little to sustain any specific theory about cognitive change beyond the peaks and valleys of metabolic and EEG activity. But, as Fischer (Fischer & Rose, 1993) and Case (1992b) and others have argued, the ages at which these changes take place are consistent with both classic and neoclassic stage theories of development.

The Stage Question in Developmental Psychology. Although at present general stage theories of cognitive development are not popular, until recently it has seemed natural to most students of development to think in terms of stages, whatever one's theory of structure, function, or process might be. Even the most stringent behavioral psychologists of the 1950s and 1960s recognized stage differences early in development (Bijou & Baer, 1965). But stages then were considered somewhat ad hoc to those who believed that a single process – learning – explains developmental

change throughout life. The idea of stages was tainted by the maturational "explanations" associated with Gesell *(1940),* which were generally held to be circular and nonexplanatory [see Kessen & Kuhlmann (1962) for discussion]. These biases were projected onto Piaget's proposals when they came to the wide attention of American researchers in the 1960s. Although the idea of cognitive stages was certainly not new (Piaget's echoed Baldwin's from earlier in the century), Piaget's elaboration of them met widespread skeptical resistance among American researchers schooled in learning theory.

The "stage question" as represented in Piaget's theory persisted into the 1970s, even as Piaget's thinking was permeating the field of developmental psychology (e.g., Gelman & Baillargeon, 1983; Brainerd, 1978). One of the results of the confrontation with Piagetian work was the widespread effort to find earlier and earlier evidence and precursors of cognitive capacities that were held to be characteristic of a particular stage in Piagetian theory, for example, with respect to the conservation of number (Gelman & Gallistel, 1978) and logical classification (Donald-son, 1978). These efforts appeared to doom the discontinuity assumption of the stage notion, leaving only a shell of the former claims. Except for orthodox Piagetians and neo-Piagetians most developmentalists since have either avoided the stage question altogether or have opted for a kind of middle ground, admitting stages of development within do-mains, but not "of the whole" as in Piaget's theory. The debate today is not usually about stages per se, but about conceptual change and its mechanisms within domains or modules. If major changes persist in being identified with the classical periods of childhood and adolescence, that fact tends to remain unacknowledged.

But through it all, stages will not go away. Shakespeare, Freud, and Erikson, as well as Gesell and Piaget, not to mention developmental biologists, have all noticed dramatic changes from infancy to early childhood, to middle childhood, to adolescence. Do adolescents think differently from preschoolers? Most laypeople, most educators, and, in their nontheoretical modes, most developmental psychologists would not hesitate to answer affirmatively. The question is: How can the differences be characterized and to what can they be attributed?

Ontogenetic Parallels with Phylogenetic Stages

At first glance, the evolutionary story that Donald has set forth presents an obvious parallel with standard stage accounts of human cognitive development. The parallels with three general theories are displayed in Table *3.3.*

Table *3.3. Parallels between Donald's phylogenetic stages and developmental stages*

		Cognitive Stage		
Age Stage (Phylogeny)	Age (yrs.)	Piaget (1970)	Bruner* (1966)	Vygotsky (1962)
Infancy (Primate)	0-1 1/2	Sensorimotor	Enactive	Natural
Early childhood *(H. erectus)*	1 1/2 - 5	Preoperational	Iconic	Preconceptual
Middle childhood *(H. sapiens)*	6-11	Concrete operational	Symbolic	Conceptual
Adolescent (Modern mind)	12-adult	Formal operational	?	Scientific

*Bruner, Olver, & Greenfield (1966).

This table does not begin to suggest the commonalities and distinctions among these different theorists, or the major content of their theoretical stages. In particular, Bruner and his colleagues (1966) did not elaborate beyond the symbolic to an adolescent stage, and Vygotsky did not lay out such a scheme in so many words - rather it is implicit in his description of phylogenetic and ontogenetic conceptual developments.[14] However, what the table does suggest is that these theorists saw different kinds of cognitive functioning emerging at similar points in development, although their characterization of the differences varied considerably.

There are obvious problems with this kind of direct analogy. The first and simplest problem is that none of the ontogenetic cognitive stages proposed are directly analogous to Donald's evolutionary stages. Event [r]epresentations are not the same as sensorimotor schemes (Piaget, 1970), nor are they the same as enactive representations, which are more like procedural memory than episodic memory (or general event memory). The early childhood stage was considered by Piaget to be the first [r]epresentational stage, reflecting the onset of symbolic representation. In his theory imitation played a central role in the establishment of symbols; thus there may be a convergence with Donald's idea of mimesis. Nonetheless, the parallels are not strong. Even less strong is Bruner's stage of iconic representation, the idea in his theory being that

preschool children are "centered" on perceptual figures, but when deprived of perceptual representations (e.g., pictures) they can operate on a more abstract level.[15]

Piaget's stage of concrete operations is conceptualized in terms of the emergence of logical thinking, quite a different proposition from Donald's proposal of mythic/narrative thought. In his 1966 theory Bruner followed Piaget rather closely in his descriptions of thinking at the symbolic level (for example, in the achievement of inclusive classification systems), thus also stressing logical thought. More recently, Bruner (1986, 1990) has emphasized narrative thinking as a basic form of thought, thus mapping more closely onto Donald's thesis.

Piaget's final stage of formal operations would fit more closely with Donald's last stage of theoretic thought; both are found to depend on the availability of language, and in Donald's case (less clearly in Piaget's) external representations. Bruner and colleagues' (1966) theory was not developed beyond the symbolic stage. Thus overall and specifically the first approximation of cognitive stage theories to Donald's evolutionary stages moving toward the hybrid modern mind does not work. But Vygotsky's theory appears to offer a closer match than the others, whether considered from the perspective of stages of semiotics. Note first, however, that none of the cited developmental stage theories are integrative in the sense of one stage being incorporated into the next; rather, they all fit the levels and layers of the hybrid mind model.

Vygotsky's Program in Thought and Language *(1934)*

The program that Vygotsky set forth in what is widely considered to be his classic statement of cognitive development and the relation of thought and language [or closer to the Russian meaning, "thinking" and "speaking" – Kozulin (1986)] had much in common with the evolutionary perspective outlined in this chapter. Vygotsky began with phylogeny, considering what was then known of ape cognition and communication, based on the research that was available in the 1920s. The "natural" course of development exemplified by nonhuman primates gave way in his view to the sociocultural when language entered thought. Words and word meanings were for him the basic units of analysis of thinking.

In contrast to the universalism of Piaget, Vygotsky saw cognitive development unfolding within a cultural-historical framework. Cognition in this perspective would develop in different ways (and to different levels) depending upon its cultural conditions. The social-communicative function of language played the central semiotic mediation role in cognition. Culture and cognition were internalized by the child through externalized transactions with adults – parents or teachers – who made implicit relations manifest in learning situations. Scientific thought in particular was seen as imparted from the culture to the child in pedagogical situations; the child's problem was to reconcile the spontaneous concepts, formed on the basis of pragmatic experience, with the scientific concepts externalized by the culture. Luria's (1976) studies based on these ideas have been extended by Tulviste (1991), who provides a good summary of them.

Vygotsky (1978) also viewed external aids in memory and attention as mediators of thought in a way that is similar to Donald's ideas about ESS, emphasizing the cultural history of such aids, and their different distribution across historically differentiated cultures. People in different societies could be expected to think differently according to the availability of mediational means. These ideas, again, are quite consistent with Donald's views. In addition, Vygotsky's idea of scientific thought had much in common with the theoretical culture espoused by Donald, and his emphasis on language and on semiotic mediation is also highly compatible with this view. Neither Vygotsky nor his present-day followers, however, considered the role of mental model building, in layers and levels of representation, or the idea of the hybrid mind. Rather, Vygotsky viewed the "higher mental processes" as culturally developed, taking over the function of "lower" "natural" processes, which could be revealed again in cases of brain damage. Nonetheless, Vygotsky recognized the importance of writing, and of material aids, tools and other cultural artifacts and technology to thinking, consistent with Donald's focus on the significance of external support systems [see Raeithel (1994)]. Moreover, Van der Veer and Valsiner (1991) point out that in considering child development as a science, Vygotsky stressed that the individual experiences the environment differently at different ages or developmental stages.

Overall, Vygotsky's theory has much in common with the Donald proposals. Indeed, Van der Veer and Valsiner's (1991) tracing of the history of thought in the late nineteenth and early twentieth centuries, on which Vygotsky drew in developing his own theory, evokes the point that Donald's thesis is a modern version of the historical approach to understanding mind, common to Darwin, Baldwin, and others of the earlier period, and reconstituted in Vygotsky's mature work. In further exploring these connections it becomes clear that the present work is

quite close to Vygotsky's general approach, and to some versions of present-day cultural theory, derived ultimately from the same source.

Many other theorists recently have proposed alternatives to standard cognitive theories, with their emphasis on the disembodied autonomous mind. In reaction they have stressed that the mind must be situated in the body, and the body must be situated in the world (e.g., Varela, Thompson, & Rosch, 1991); and when the body is a human body, it becomes important that the world is both social and cultural. "Enactive cognition" [Varela, Thompson, & Rosch (1991); see also Bickhard (1987); Lakoff (1987); Johnson (1987)] addresses some of the same issues as the evolutionary concerns expressed by Donald, based on the premise that individual cognition begins with experience and experientially based knowledge. This perspective does not deny that either acquisition or organization is constrained by humanly possible structures, but stresses that the constraints and potentials in the system may come as readily from outside the organism as from within it.

Experientially Derived Event Knowledge

As outlined in Chapter 1, studies of event knowledge in infants and young children were the basis for earlier versions of the model developed in this book organized around the proposal that general event representations are the "basic building blocks of cognition" (Nelson & Gruendel 1981; Nelson, 1986). This idea is echoed in Donald's statement that "the episode is the 'Atom' of ape experience, and event perception is the building-block of episodic culture" (p. 153). Our basic thesis was that infants and young children represent the important events that they participate in in a general format that enables them to take part in the social activities of their familiar settings. Important events are those in which they are participants, whether actively or passively; that recur frequently, such as caretaking routines and simple games; or that evoke significant affective responses.

Event representations are basic to adult human everyday knowledge systems, as well as those of apes, infants, and children. We do not outgrow our dependence on expectable event knowledge; it forms an important part of our hybrid cognitive system. However, as Donald noted, "Animals excel at situational analysis and recall but cannot represent a situation to reflect on it, either individually or collectively" (p. 160). To become a cognitive building block, the event representation must become accessible to reflection. It must also become integrated with, and somehow receptive to, a system of symbolic representation. This development was implicated in the event representation work, where event representations were seen as the source of concepts and categories and the support of language acquisition. Later chapters of this text spell this out. The idea of layers and levels of representation was also an important part of the event representation story (Nelson, 1986). Moreover, language was seen as learned and developed within well-understood, familiar event routines. All of these proposals appear consonant with Donald's suggestions, and they are elaborated in the chapters to follow.

Preliminary Synthesis and Thesis: The Hybrid Mind in Development

Invoking a developmental approach to the problems raised by Donald's theory requires taking the view that the developing individual constitutes a system of developing strands — skills, capacities, interests, emotions, activities, situations, physical strength and size, social settings and partners, concepts, memories, and other strands recognized and unrecognized as contributing to the developing mind. As the study of nonlinear systems has revealed (e.g., Van Geert, 1993), from the convergence of strands or separate influences there may come the emergence of new levels of organization. This kind of emergence of more complex organizations from the combination of independently changing components without the necessity of a single mechanism or push is clearly compatible with the observations and theses of stage theorists. Although in most cases of cognitive development it may be difficult or impossible to trace the contributions of each bit to the whole and to model the developments accurately, nonetheless the framework is appealing.

In language, in memory, in conceptual growth it is clear that there are no single effective pushes to the developing system but rather a combination of influences that lead to observable change. It is a major challenge to the field to break away from the search for single causal mechanisms and to trace instead the independent and interacting forces that operate within each developing domain of interest. In the areas under examination here a major role is assigned to language as a representational medium, but this role is conceived to be at once a product of ongoing communicative and cognitive developments and a catalyst for further change, in ways that are quite similar to, but on a different scale from, what Donald has traced in the evolutionary scheme.

Table 3.4. *Developmental stages mapped onto evolutionary stages*

Stage	Age	Cognition	Language
Infancy/*episodic*	0 - 1 1/2	Event reps.	Sounds, first "words"
Early childhood/ *mimetic*	1 1/2 - 4	ERs with words Games, play, songs, social rituals	Dialogue Grammar developing, language in mimetic reps.
Middle childhood/ *narrative*	4-10	Narrative thinking, personal memory, cultural learning	Narrative Beginning reading and writing, math, categorical schemes
Adolescent/ *theoretic*	10-adult	Logical abstractions Deductive systems Extensive use of external systems Acquisition of "scientific" social-conventional knowledge	Logical abstractions, argument and scientific reading and writing, specialization

Table 3.4 instantiates one form of a developmental analogue to Donald's scheme, mapping hypothesized developmental periods onto the evolutionary scheme. Donald's labels for the different stages (episodic, mimetic, and theoretic) are included here for heuristic purposes. Although as noted previously we could not expect the human child today to proceed through the same stages in the development of representational systems as in evolutionary time, retaining the labels is a reminder that earlier forms of representation exist and are operative throughout development, and the possibility exists that a particular type of representation might emerge and dominate during a particular period of ontogenetic development.

For each stage aspects of cognition and language are sketched in. There is no implication here that the developments listed are in any way exhaustive of thinking during the period. For example, conceptual development and number are absent from the table, although the former will be considered in some detail in a later chapter. What the table is meant to convey is that some developments that seem to be interconnected and perhaps intertwined, and that are related to those that were significant in the evolution and history of complex cognitive systems, are developing together over periods of developmental time.

Note that the major transitions are associated with acquisition of linguistic forms (grammar, written language) and with new language functions (dialogue, narrative, formal argument). The implication through all of this is that it is human language and its potential for different ways of formulating thought that has driven and continues to drive human cognitive development on both the evolutionary and the individual scale. It must be emphasized, however, that this claim does not imply that human cognition is totally dependent upon language; there is every evidence that cognition without language is complex and powerful. But at every point, language amplifies and advances thinking in directions that it would otherwise not be possible to go.

Of the potential power of language and its derivatives (graphic forms, printed documents, computers), by far the most significant is the potential that it provides for sharing representations with other people and deriving benefit from the knowledge constructions of others. This power is observed at every step in development from first words to scientific theory making. What is remarkable is how little heed developmentalists, and psychologists in general, have paid to its significance for cognitive growth, knowledge acquisition, and theory construction. In the remainder of this book these connections will be spelled out in more detail, whereas the biological foundations are hereafter assumed but not further explicated.

The discussion in the chapters to follow concentrates on developments during the transition from the prelinguistic representation stage (0 to 4 years) to the oral language representation stage (4 to 10 years). Developments during this transition period (roughly between 3 and 5 years) are quite dramatic in a number of domains; recent research has concentrated on this period, projecting explanations for the changes observed from different theoretical positions. The thesis here is that many of the changes observed during these preschool years result primarily from the emerging potential to represent knowledge in linguistic formats, and the corollary potential to exchange knowledge with others, in particular with more knowledgeable adults. Some attention must be paid as well, however, to developments that may not be dependent upon language representations. Identifying examples of each kind will help in developing a theory adequate to explain developments in this particular stage of life.

Later transitions are thought to represent more variable, more technologically and educationally dependent pathways. There is no implication here that early developments are critically deterministic of later potentials, in the sense of setting trajectories, but the initial shift to language representations is crucial to subsequent developments of written lan-

guage and thought, including both narrative and theoretical knowledge structures. This brings out a point that is too often hidden in our theories. Development is teleological, and to prepare for language representations, one must first learn language, just as to become a scholar one must first learn to read and write. Many tasks of childhood do not serve the immediate goals of that period but are preparatory for the next stage. This poses a challenge to our theories that has not been met by any that focuses solely on the individual mind or on specific domains of knowledge.

In the course of the consideration of the developments traced here, two issues emerge that will receive some illumination. One is the issue of conceptual change, which has been the focus of debate in recent years (e.g., Carey, 1985; Carey & Gelman, 1991). What is the mechanism of change? What drives the developmental system? The real task for stage theories is not to describe stable states (which may never exist) but to trace the dynamic of change. The other central issue is the conceptualization of the social mind: How is the psychological to be reconciled with the social-cultural world without becoming its puppet? How is psycho-logical integrity to be maintained in the face of overwhelming social semiosis? It has been intimated in the preceding discussion that the solution from cognitive science has been to shut off the mind from out-side influences, to consider the mind as an autonomous encapsulated organ, operating on decontextualized "information." When this move is viewed as illegitimate, as it is here, what is left of individuality? These questions will be set aside while the more prosaic and pragmatic developments are unfolded in the chapters that follow, but they will be raised anew in the final chapter.