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Evolution

Two great theoretical divides impact debates on the evolution of language. One differentiates those who posit that sharp, relatively unbridgeable, qualitative gaps separate human and animal minds from those who see continuities between animal and human mental faculties. The second differentiates those who consider that human linguistic abilities reflect general cognitive and neurological capacities from those who consider linguistic abilities to be qualitatively different from other mental capacities.

The human qualitative uniqueness position is epitomized by Descartes' postulates that animal behavior is instinctive but human behavior is rational, and by Morgan's Canon that one should always assume that animal behaviors are controlled by the simplest possible mental faculties. In recent decades, scholars of this persuasion have proposed that only humans possess consciousness and varied mental capacities, including symbolic and syntactic capacities. The contrasting continuity position was first fully elaborated in modern scientific terms by Charles Darwin, who proposed that mental differences between animals and humans are matters of degree, not of kind. It persists today among many primatologists and evolutionary biologists.

These dichotomous views have distinctly different implications for the evolution of language. Human uniqueness theories readily lend themselves to concepts that humans possess qualitatively unique, genetically determined, language-specific, neural structures. Continuity theories lend themselves to interpretations that language emerged from quantitative increases in neural tissues and that the same neural structures may contribute to different human behaviors.

Comparative neuroanatomical and behavioral evidence lend support to continuity positions. No unique anatomical structures are known to exist in the human brain. In contrast, evidence for quantitative differences between animal and human brains is solid and indisputable. The human brain

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is approximately three times as large as the average great ape brain. Several major neural structures including the neocortex, cerebellum, and some portions of the limbic system are also about three times as large in humans as in apes, and the basal ganglia, hippocampus, and diencephalon are about twice as large. Behavioral studies indicate that great apes possess rudiments of nearly all behaviors once thought to be uniquely human, including symbolism and syntax, but that many human behaviors have expanded in response to neural enlargement. Specifically, humans possess greater mental constructional skills (mediated by the neocortex) and greater procedural learning skills (mediated by the basal ganglia, the cerebellum, and the premotor cortex).

Mental construction is ability to join two or more perceptions, objects, actions, or concepts in order to create new, more information-rich, constructs and to embed these new constructs into still higher-order constructs. Humans and great apes exhibit mental constructional abilities in varied behavioral domains. In each domain, human skills exceed those of the apes. In the motor realm, mental construction evidences itself when positions of several body parts are simultaneously coordinated to construct gestural, tool-using, dance, or gymnastic postures, and when dance and gymnastic routines are constructed from a predetermined sequence of postures. Similar mental constructional skills allow humans to produce individual speech sounds by varying the configuration of the tongue, lips, and other vocal organs and to construct words and sentences from sequences of vocal tract configurations.

In conceptual domains, mental construction evidences itself in tool-use, art and architecture, language, and social behavior. Chimpanzee tool-using behaviors demand the construction of relationships between a tool, such as a hammerstone, and the object of the tool-use, such as a nut or another stone. Humans, however, construct tools of varied components. Even simple tools, such as spears with stone points, require an initial manufacture of the tool components (stone points, wooden shafts, binding materials) and the conjunction of separate components to form the final product. Thus individual components are "embedded" or subsumed within the final tool. Human artistic and architectural products utilize similar processes of manufacturing diverse components that are then embedded in a larger final object.

In the social realm, mental constructional skills are evident in behaviors that require an understanding of the thought processes of other humans or animals (theory of mind). Dennett has delineated several orders of theory of mind. These involve different levels of mental constructional skills and different levels of embedding. Hence, a first-order construct takes the form "Y believes that Q . . . ," while a third-order construct takes the form "Y wants Q to believe that Y believes. . . ." Great apes engage in deceptive behaviors that suggest the presence of some abilities to understand the thought processes of others. Only humans appear capable of higher-order constructs such as "I think that Susan thinks that Bill thinks that she is smart."

Ape versus human linguistic endeavors exhibit mental constructional differences similar to those in other behavioral domains. Apes can use simple

visual symbols and combine two symbols according to syntactic rules. Humans routinely construct multiword utterances containing embedded phrases and clauses. Thus a great ape can create a construct such as "give milk," but humans can construct linguistic utterances such as "Please remember to put milk in the kitty's dish before you leave for the basketball game."

Many motor and conceptual constructs are unique one-time events. Others become routines after much practice and repetition allow them to be executed rapidly and automatically with little conscious thought (procedural learning). Young apes and humans, for instance, practice intensively until finally mastering culturally specific tool-use techniques, and human infants practice movements of the vocal tract until they can effortlessly pronounce their native language. Humans also learn to automatically generate symbolic gestures and syntactic structures, to automatically recite some factual information (e.g., the alphabet, the days of the week), and to automatically reproduce culturally specific rituals and songs. Without these expanded procedural learning abilities, human culture and language could not exist.

To conclude, language depends on mental constructional and procedural learning capacities that also underlie other human behaviors. These capacities exist in apes in more rudimentary form, and they depend on the processing capacities of varied neural structures that have enlarged in human evolution. These findings lend support to continuity theories of language origins.

(See also *acquisition, brain, category, grammar, individual, socialization, turns, writing*)

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