

INTERACTION OF DEVELOPMENTAL AND EVOLUTIONARY PROCESSES IN THE EMERGENCE OF SPOKEN LANGUAGE

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Evolution is a two-stage process (West-Eberhard 2003). In the first stage, a plastic phenotype responds to environmental variation, producing novel forms that vary genetically. In the second stage, selection acts on the variants. From Mivart (1871) and Garstang (1922) to the new evolutionary developmental biologists (Northcutt, 1990), it has been argued that the first stage--the origin of novel characters---can only occur in development. While vigorously supporting this view, the new Evolutionary Developmental Biology (termed “evo-devo”) has also demonstrated reverse order (“devo-evo”) effects of evolution on development (Gilbert, 2003; Hall, 2000; Jablonka & Lamb, 1998; Wagner et al., 2000). Indeed, for some, each of the two processes---evolution and development---is an *explanandum* as well as an *explanans* (Robert, 2002).

Since traits that emerge in development frequently do so as the result of a change in behavior (Bateson, 1988; Gottlieb, 2002), it is essential that theories of linguistic evolution place a high valuation on developing behaviors. Recently, in collaboration with Barry Bogin, I have argued that evolution produced a new ontogenetic stage and remodeled an existing one; and that developmental processes, operating in the new and remodeled stages, produced novel behaviors that were naturally or sexually selected (Locke & Bogin, in press). The net effect of these evo-devo and devo-evo changes, as proposed, was an increase in the frequency of genes supporting precursors to, and ultimately the components of, spoken language.

An example of a revision of an existing ontogenetic stage is the effect of bipedalism (and antecedent events) on infancy. It has been suggested that this change redesigned the hominid nervous system (Eccles, 1989) and introduced new ways of interacting (Jablonski et al., 2002). Bipedalism also narrowed the pelvis (Leutenegger, 1980). This caused an “obstetrical dilemma” for the expectant mother and her large-headed fetus, a dilemma that was solved by shifting skull and brain development into the postnatal period. This shift increased helplessness, extending the period and intensity of interactions between offspring and their vigilant parents.

New levels of care and sibling competition would have escalated conflict

between the infant and its parents (cf. Trivers, 1972). One solution was for infants to signal for care more strategically. I propose that infants who issued more effective care signals were more likely than others to receive care and live to reproductive age (Locke, in press). I also propose that infants who cooed and babbled at appropriate intervals were unusually likely to engage with adults, to receive more sophisticated forms of care as infancy progressed, and to generate and learn complex phonetic patterns. These benefits would have accrued particularly to infants who monitored adult reactions (Chisolm, 2003) and adjusted their vocal output accordingly.

At some point, it became possible for infants to “cry wolf,” that is, manipulate their voices in such a way as to appear more needy or worthy than they really were (Hauser 1986). If mothers wanted to devote more time to other infants and tasks, they would have had to monitor their infants’ vocalizations more carefully, and learn to discriminate the sound of tactical signals from sincere ones. Thus, I suggest that the increase in infants’ helplessness would also have enhanced parental ability to interpret infant vocalizations (Brockway, 2003; Locke & Bogin, in press).

An example of a new ontogenetic stage is childhood, a uniquely human stage that entered the *Homo* line about two million years ago (Bogin, 2001; 2003). Coterminous with weaning, chimpanzee infancies last five years. During this period, maternal lactation suppresses ovulation, limiting the rate of population growth. Hominid mothers weaned their infants earlier, decreasing inter-birth spacing and increasing the number of possible offspring. The years liberated by an earlier weaning created a short, two-year childhood, with different characteristics than infancy and the juvenile stage that follows. These characteristics would have favored the invention of vocal and symbolic behaviors by the young (Locke & Bogin, in press), conferring benefits that contributed to the extension of childhood, additionally, to its present four-year duration.

New childcare pressures would also have increased reliance on *surrogate* parents, or babysitters (Hrdy, 1999). In traditional societies---the social arrangements most closely resembling the environments of evolutionary adaptedness---cooperative breeding is essential. A possible linguistic benefit was decontextualization---a special feature of human language (Hockett, 1977)--inasmuch as infants would have encountered a wider range of individuals who (a) knew less about them, (b) operated on broader and less certain schedules of caregiving, and (c) felt less responsibility for them than the mother would have. A natural result, presumably, was an added measure of vocal and

communicative flexibility, and increased ability to manipulate, and read, caregiver intentions.

The effects of an altered infancy and new childhood would also have jacked up the value of parental instruction. In human societies, the young are exposed to a range of potentially dangerous objects and conditions, new risks emerging with the development of walking and other motor functions. Those who pointed and vocalized in response to visual attractions would have learned more about their environment, and negotiated those environments safely and successfully (cf. Caro & Hauser, 1992). It is proposed that the joint use of manual and vocal signals increased fitness over the course of numerous ancestral ontogenies. A secondary effect was increased command of vocal behavior, for there is evidence in modern infants that manual activity increases the frequency and syllabicity of vocalization (Ejiri & Masataka, 2001; Iverson & Fagan, 2004), and it has been reported recently that manual-vocal combinations are unusually likely where the infant's intentions are communicative (Locke, in submission). Thus it is claimed that motoric and referential functions jointly contributed to our species' volubility, and roused the mandibular and articulatory systems responsible for the production of speech-like sounds.

Of course, sounds without symbols only go so far (Hurford, 2004). Fortunately, the developments discussed above would also have favored the evolution of sound-meaning relationships. This issue was partially addressed by Fitch (2004), who argued that parents would have benefited by communicating accurate information to their offspring. The better informed young, according to Fitch's functional proposal, would be more likely to survive into adulthood, passing on to their own offspring genes associated with the improved system of communication. Continuity being a hallmark of human development, infants and children who achieved effective use of sound-meaning signals would have carried some form of the relevant control behaviors into juvenility and adolescence. In those stages, I claim, vocal and verbal skills facilitated the quest for status and sex (Locke, 2000; Locke & Bogin, in press), selection automatically strengthening---in a second hit---precursive behaviors that persisted, in some form, from earlier stages.

There is evidence across all the stages of life history to the effect that speech attracts attention, that attention raises status, and that highly vocal individuals enjoy higher status than less vocal individuals. Dominance hierarchies begin to form as early as five years (Strayer & Trudel, 1984), and these are based largely on vocal and verbal behavior (Hold-Cavell & Borzutsky, 1986). Among the status-enhancing developments, depending on the culture,

are riddling (McDowell, 1979), joking (McGhee, 1979; Shultz & Horibe, 1974), and dueling rhymes (Dundes et al., 1970). In 3- to 5-year old African American boys, Wyatt (1995; 1999) has observed an elementary form of “the dozens,” a duel---usually “fought” by adolescents and young adult males---and a clear case of “rap.”

I suggest that in traditional (oral) societies, the vocal and verbal abilities that enabled adolescents and young adults to engage and compete with others, and to perform in public arenas, indexed fitness and were selected. If so, there may be a genetic basis for verbal expressivity and dominance in modern humans, a prospect supported by several adoptive twin studies (Gangestad & Simpson, 1993; Lykken, 1982; see also Snyder, 1987).

My claim, then, is that insertion of new or remodeled ontogenetic stages into human life history produced new developmental processes that fashioned novel communicative behaviors, and that these increased fitness. If so, reciprocal action by evolutionary and developmental mechanisms---specifically an “evo-devo-evo” sequence---may have played a major role in the evolution of language.

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