

According to DST (Thelen & Smith 1998; cf. Lickliter, in press; Oyama 2001), form is a product of process: *Changes in developing systems are not predetermined by a grand design*. To the contrary, they are shaped at the local level during the process of an organism's interaction with its immediate environment. Similarly, the evolution of language did not take place in a vacuum (Johansson 2005). Evolutionary changes culminating in language were the result of selectional pressures at the local level, always shaped by interactions between members of the species and their immediate environment. L&B provide rich examples of these local-level selectional pressures that resulted in key changes that, in turn, facilitated the onset of language in evolving humans. For example, extension of the period of brain volume increase into postnatal life, to ease the obstetric problem of cephalo-pelvic disproportion in human females (caused by bipedalism), likely caused increased dependency of infants on adults, requiring extensive postnatal care. Greater physical handling by human caregivers, in turn, resulted in greater social stimulation and infant-caregiver interaction, and greater neurological development, eventually facilitating language in humans.

The preceding example also highlights a second tenet of DST: *multiple causality in emerging systems*. According to this tenet, changes occurring in a system – neurological, physiological, or behavioral – are the complex product of interaction between many factors at multiple levels (Lickliter, in press). Therefore, attributing primary causal status to any one factor or level is inadequate. This tenet, also applicable to language evolution, is well represented in Oyama's idea that change occurs via interactive co-construction: "The idea of construction through interaction of many different factors is applicable to evolution as well as development, and it highlights striking similarities between the two processes" (Oyama 2001, p.6).

Third, according to DST (Thelen & Smith 1998), *stability or lack of variability is inimical to change*. Changes in an emerging system are driven by instability or perturbations (at the local level) during ongoing organism-environment interactions (Kelso 1997). Therefore, a few collective variables, if accurately identified, and the collective organism's ability to self-organize in response to the changes in these variables (or control parameters) can explain change at any given point in time. To identify these control parameters, evolutionary theory must turn to robust empirical findings from life-span development, as prescribed and practiced in the target article.

Finally, because much theorizing about how language evolved depends on post hoc evidence from ontogeny or life-history, as the authors suggest, predicting changes along extended time-scales might be possible by turning to the newly emerging field of *epigenetic robotics*. In this field, computational modeling of human development and its dynamics over multiple time scales is feasible. It involves the design and construction of artificial systems with adaptive, developmental algorithms, using key parameters that constitute specific behaviors of developing natural systems (Blank et al. 2005; see review by Prince et al. 2005). Future epigenetic models of language evolution would require architecture that is not fully specified. Fully specified systems are by nature predetermined by a grand design (e.g., see Hurford 2002; Kirby 1999b). These systems neither *develop* nor *evolve* by adapting to their local environment, and therefore are not accurate models of natural evolutionary processes. An alternative approach to modeling evolutionary changes in biological systems would require designing artificial systems to simulate self-organizing behavior and ongoing environmental interactions over extended time scales. These systems would adapt to perturbations at a local level (or levels).

In conclusion, future models of language evolution would need to include key parameters that do not fall strictly within the language domain. For example, consistent with developmental theory (e.g., Gogate et al. 2001; 2006), models of language evolution should find it useful to include the sensory and intersensory precursors to language development, to accurately model the

process of language evolution from basic perceptual processes (Dominey & Boucher [2005] model syntactic acquisition using auditory and visual inputs; Prince & Hollich [2005] model infant auditory-visual perception and word-mapping). This domain-general approach to modeling language evolution would complement the multi-domain perspective embraced by L&B in their life-history approach to language evolution.

## Why don't chimps talk and humans sing like canaries?

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**Abstract:** We focus on two problems with the evolutionary scenario proposed: (1) It bypasses the question of the origins of the communicative and semiotic features that make language distinct from, say, pleasant but meaningless sounds. (2) It does little to explain the *absence* of language in, for example, chimpanzees: Most of the selection pressures invoked apply just as strongly to chimps. We suggest how these problems could possibly be amended.

We agree with Locke & Bogin (L&B) on the importance of considering ontogeny in evolutionary studies. The unusual human developmental pattern may indeed provide insights concerning language origins. The emphasis of L&B on functional and pragmatic aspects of language is likewise commendable. However, these need to be integrated within an account of the origins of the semantic and grammatical aspects that make language a unique semiotic system allowing the communication of *detached representations* (Gärdenfors 2003) and the construction of narrative (Donald 1991). Since this is not the case, there are at least two major problems with the specific selective scenarios proposed by L&B.

**Why not just sing?** A major feature of language distinguishing it from all animal vocalizations is its ability to express an endless number of *thoughts* in various complex *combinations*. A plausible scenario of language origins needs to explain this enormous expansion of semiotic functionality. But Bickerton's argument against Dunbar's (1993) verbal-grooming hypothesis, about which he writes "a similar result could have been achieved simply by using pleasant but meaningless noises" (Bickerton 2003, p. 79), applies to a considerable extent against L&B's scenario as well. Or as an informant of Folb (1980), quoted by L&B, puts it: "Don' hafta make whole buncha sense, long sounds pretty" (sect. 7 of the target article).

The first stage in L&B's two-stage scenario concerns parental-care elicitation during infancy and childhood. There are certainly strong selective pressures at work here, but, as noted by L&B, the interests of parents and offspring do not coincide. This would more likely drive the evolution of manipulative signals rather than cooperative interaction and communication, as it has, for example, among many birds.

The second stage concerns sexual selection among adolescents and young adults. The common theme in L&B's lengthy discussion of oral societies is the importance of form and presentation over content. One would reasonably expect this to drive the evolution of ever more elaborate form – but why would it drive the evolution of content? Isn't it more likely that a scenario driven by sexual selection and status competition would result in something more resembling birdsong than language? Invoking sex and

status as important factors in language origins is in itself not implausible. But in order to explain the distinguishing features of language, selection for content must be part of the scenario. The proposal of Miller (2000), discussed by L&B at the end of section 5, goes in the right direction: "Language put minds on public display, where sexual choice could see them clearly" (Miller 2000, p. 357, quoted in L&B). Related ideas are proposed by Dessalles (2000), in which status is gained through public speech containing *relevant information*, thus placing selective pressure squarely on the ability to provide content. L&B do refer to the work of Dessalles, but by focusing too much on form rather than content, they leave a gaping hole in their argumentation.

L&B do attempt to motivate the primacy of vocal abilities over grammar in their scenario, by arguing that it makes more sense for speech to evolve before syntax than vice versa. This is not self-evident, for several reasons. First, grammar is not just "syntax" but *patterned content*, which has been emphasized for decades by functional and cognitive linguists (e.g., Langacker 1987). But L&B don't even refer to this healthy tradition and mistakenly seem to equate "linguistics" with Chomskyan linguistics. From the cognitive perspective, it is completely possible that manual gestures and bodily mimesis provided the basis for propositional structure (Armstrong et al. 1995; Corballis 2002; Donald 1991; Zlatev et al. 2005), a possibility that L&B shunt aside in a footnote. And even if speech were the original modality, coevolution between speech capacity and grammar should not be discounted.

In brief, by separating vocal abilities from content and grammar, the scenario of L&B is hardly a scenario for *language* origins anymore. The aspects of language that are uniquely human remain unexplained.

**And why not chimps?** In the case of specifically human adaptations like language, it is not enough to present an evolutionary scenario showing how useful language would be for our apelike ancestors. The question that needs to be answered is not just why our ancestors evolved language, but also why chimps did not, even though we share a fairly recent common ancestor. It must be shown that language was useful and adaptive specifically for proto-humans *and not* for proto-chimpanzees. Many language-origin scenarios fail this test (Bickerton 2002; Gärdenfors 2004; Johansson 2005).

Using vocalizations strategically in the context of parental-care elicitation is hardly unique for humans – many birds and mammals, including primates, do so. Given that human childhood as defined by L&B is the result of earlier weaning, that is, a *decrease* in parental care allowing diverting resources from the current child to its future siblings, it is not clear how this can function as a selection pressure for human toddlers to be *better* at eliciting care than their chimp cousins, who still manage to get breast-fed at that age.

In the vocal competition among adolescents, impressiveness and attention-holding are important factors. As noted by L&B in the beginning of section 5, the same factors are important in establishing status also among nonhuman primates. Again, it is not at all obvious why this led to language among proto-humans but not proto-chimps, despite both being subject to similar selection pressures in similar contexts.

Similarly, at the end of section 9.1, L&B claim that for young hominids "even a small amount of vocal-verbal behavior would have facilitated warnings and instruction," but they do not explain why the same mechanisms would not apply to proto-chimps.

Still, we do believe that buried in L&B's account there is the germ that may save them from the "why not apes?" test. It is spelled out in section 13: "bipedalism is ... a key event ... for this ... produced, in time, pelvic narrowing. Remodeling of the birth canal caused a shift of skull and brain development into the postnatal period, increasing the degree and duration of infant helplessness" (target article, sect. 13, para. 2). This

together with the need of bipedal mothers to *carry* their young, would have led to the need for more *cooperation* rather than competition between mothers and infants, and to an increase in the quality of dyadic interactions in the form of mutual gaze, mutual imitation, and proto-conversations (Falk 2004). These are species-typical characteristics of human beings laid down in the first nine months of life, and serving as the basis for the development of joint attention and pointing in the second year (Hobson 2002; Tomasello et al. 2005), which are milestones of infancy bootstrapping into language – of which L&B say nothing.

**Conclusion.** L&B's basic proposal that there may be connections between these two uniquely human features, language and life history, is interesting and worth pursuing further. But more care should be taken in designing selection scenarios, so that the proposed selection pressures actually work in the right direction, towards the development of the "socially shared symbolic system" (Nelson & Shaw 2002) – that is, language – in the human lineage only.

## The evolution of childhood as a by-product?

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**Abstract:** The proposition that selective advantages of linguistic skills have contributed to shifts in ontogenetic landmarks of human life histories in early *Homo sapiens* is weakened by neglecting alternative mechanisms of life history evolution. Moreover, arguments about biological continuity through sweeping comparisons with nonhuman primates do not support various assumptions of this scenario.

The evolutionary scenario concerning the interaction between life history and language evolution developed by Locke & Bogin (L&B) suffers from two weaknesses. First, while L&B's focus on early stages of the life history cycle is new and laudable, they fail to recognize the possibility that shifts in the relative duration of early life history landmarks can also be brought about by selection on fitness-relevant traits or events later in life. Selection on a delay in the age of first reproduction is the best-studied example in this context (Promislow & Harvey 1990). It is therefore not necessarily the case that "Selection for vocal ability, and, ultimately, for language would thus have worked reciprocally to extend childhood" (sect. 2.4 of the target article). Developmental and evolutionary processes are not clearly separated in their life history model. It is therefore at least equally plausible that age of first reproduction has been delayed further in *Homo sapiens*, compared to *Pan*, *Australopithecus*, and other species of *Homo*, for adaptive reasons unrelated to language, and that the extra time that became available for juveniles was subsequently used to develop more refined linguistic skills. Alternatively, linguistic skills acquired early in life may have offset some of the costs of delayed maturity. The hypothesis that these skills were rewarded later in life through mate choice, as originally proposed by Miller (2000), is convincingly elaborated by the authors. However, these benefits accrue primarily to males, whereas life history evolution acts primarily on females (Stearns 1976) – a discrepancy also not addressed by the authors' life history model.

Second, when discussing various aspects of language development, the authors use several primate examples in an attempt to support their arguments. However, some of these examples consist of sweeping generalizations across species, sexes, and age classes that provide weak analogies, at best, to support claims about human uniqueness or biological continuity. The fact that a behavior pattern exists "in primates" does not logically imply that early humans behaved the same way. There is too much variability in behavior among the hundreds of species of