phonetically as distinct as it is now. In synthesis there was a "quasi musical" melodic signalling, whose vocal signals were able to denote at least emotional internal state. This might explain: (1) the separation of music and language competence in contemporary human brain; (2) the role of vocal communication embedded in the verbal one, and the fact that vocal and verbal signals are separately processed in the human brain (Zatorre et al. 1992); and (3) the existence of independent selective pressure for early musical sounds and late phonetic sounds.

About juvenility, the features of feminine speech, and a big leap

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Abstract: In this commentary, I ask three specific questions: (1) Why would a juvenile stage be maintained in humans? (2) What could be a satisfactory evolutionary scenario explaining the features of feminine speech? And (3), what could be the contribution of sexual selection in the elicitation of higher informational contents in communicative signals?

Locke & Bogin (L&B) provide a brilliant account of how life-history theory can help explain the evolution of the human faculty of language. Although the analysis is quite convincing and the arguments are thoroughly developed, I still have some doubts about specific matters. Though these lingering problems are not central to L&B's core hypotheses, providing proper answers could clarify and lend support to the article's main argument that human language must be conceived as the outcome of natural selection operating at all stages of development and not only on development's end-products.

Why maintain a juvenile stage? Compared to other higher primates and extinct hominids, humans have a slow life history. Also, in some important aspects, *Homo sapiens*' developmental pattern has been deeply reorganized. The infancy and juvenile stages are shorter than their primate equivalents and two new phases appear in its developmental pattern. According to L&B, infancy and juvenility could be conceived as analogous in that, both are preparatory phases. The authors provide a convincing account for infancy's reframing in human developmental pattern. An accelerated brain growth that prolongs into early childhood palliates the shorter human infancy stage. Without touching upon the dimension of language, human infancy can be primarily conceived as a phase in which occurs part of the brain growth necessary for achieving some type of autonomy similar to that of other primate species' infants (cf. the obstetrical dilemma). So, in humans, a shorter infancy stage has acquired a species-specific function, somewhat different from its longer equivalent among other species. Contrary to what they have done for infancy, L&B have not provided much specification of the species-specific status of the human juvenile stage.

The initiation of juvenility coincides with the initiation of a sharp decline in growth and the tapering-off of brain growth at about age seven years. Why do we find this interruption? Why don't we find a continuous growth from childhood to adolescence? If a juvenile stage has been maintained, it is certainly because it has somehow enhanced fitness. Even if it is a survival from a previous evolutionary stage, human juvenility is only explained if a trade-off exists between a five years' delay of reproduction and a significant enhancement of future reproduction. Also, juvenility, with its definitional features (no significant brain growth, and an accelerated decrease in body development), should be explained by the advantage that childhood and adolescence don't provide. We know that human sociality is a lot more complex than the kinds of sociality found among primate species. We also know that duration of juvenility in primates is longer than the duration of its human equivalent. Furthermore, a great deal of human middle childhood and adolescence is spent mastering social dimensions. So what can be the specificity of the juvenile phase? What is actually being learned, and what type of developmental process would be dependent upon the (relative) freezing of brain and body growth? Is the acquisition of social knowledge or skills compensating for some kind of freezing of physical development? An answer could be that juvenility is a phase during which cognition is subjected to a fast and massive energy-consumptive reorganization/reconfiguration that would allow subsequent cognitive developments to occur. But do we find evidence of such a massive reorganization/reconfiguration?

How did the features of feminine speech come about? Sexual selection shaped human language through mate choice. L&B's development of the argument seems to be slightly asymmetrical. The account of how the features of the "masculine speech" might have come into being is impeccable. It is engaging and invites us all to further investigate the matter. However, as sometimes seems to be the case in some contemporaneous sexual selection hypotheses, the feminine counterpart is inadequately dealt with. And indeed, although L&B state important features of feminine speech, they don't provide us with much elaborate justifications of why it should have acquired those characteristics. They also make a strong and unusual claim opposing the well-established idea that women often have a linguistic advantage (and what of foreign languages!?). Stating it in a rather lapidary way, men would have a greater mastery of public use of language while women would master speech in other more intimate spheres. This is a very interesting claim that it shouldn't be too hard to investigate experimentally. Are women generally out-competed when placed in a situation of verbal dueling with men? Is the topic of the dueling of any relevance? One can think of many other relevant dimensions that would be worth investigating.

From grunts to symbolic language: What role might sexual selection play? L&B present various arguments insisting on the negative social reactions to vocal and verbal deficits. And surely, those linguistic disorders are easy-to-pick signals for appraising, for instance, a potential partner's fitness . . . but they are so for people endowed with a full-blown capacity for language who, early on in development, discover its importance. So people with vocal and verbal deficits might well encounter some difficulties in meeting a mate, in stabilizing themselves in a durable relation, and in starting a family. That does not tell us much about the previous evolutionary contexts when the faculty of language and speech were evolving towards their present forms. Voice, or its texture, might have indeed been an important parameter of mate choice. But what about the content? In the same line of inquiry, one might wonder if adolescence has played a role in eliciting the big leap (either incrementally or by successive "jumps") between the uses of what could be termed indexical signs and signals with high informational content (actually linguistic, so to speak).

How the language capacity was naturally selected: Altriciality and long immaturity

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Abstract: Critical factors that appear to encourage vocal development in humans are altriciality and long immaturity. Hominid infants appear

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to have evolved a specific tendency to use elaborate vocalization as a means of soliciting long-term investment from caregivers. The development of such vocal capacity provides necessary infrastructure for language development across human life history.

By highlighting the unique human life history, Locke & Bogin (L&B) bring into focus the need to address *development* in modeling the evolution of language. Although the emphasis in the target article is on stages spanning birth through adolescence, it also bears emphasizing that even in the first six months of human life, vocal development is remarkable, and appears to bring the infant to a point of functional and contextual flexibility in production and use of vocalization that is never achieved in any nonhuman primate (Oller & Griebel 2005). The foundations laid in the first six months appear to be critical to all subsequent development toward vocal language, because it would be impossible to learn even the simplest group-specific words or even to produce systematic imitation of novel syllable patterns in the absence of substantial functional and contextual flexibility of vocalization. Similarly, it is sensible to conclude that our hominid ancestors, as they broke away from the primate background, prior to possessing language must have developed command of vocal flexibility, because, without it, all further evolution in the direction of vocal language may well have been impossible.

This evolutionary process must have been the product of specific selection forces, just as there appear to have been special selection forces that have produced vocal variability and flexibility in other species with complex communication systems, especially some cetaceans and birds (Griebel & Oller, in press). Interestingly, there are more than 200 extant species of primates (Martin 1990) but only the human shows vast vocal flexibility, suggesting that primate life circumstances have overwhelmingly favored vocal systems serving specific, immediate functional needs such as aggression, distress, or alarm signaling, and to serving those needs with well-defined, unambiguous calls (Griebel & Oller, in press; Hauser 1996). One of the most fundamental questions of language evolution then is: What was unique about hominid life circumstances that yielded selection forces where hominids and only hominids came to possess vocal capacities that vastly exceeded the requirements of immediate functional needs?

The pattern of modern human development in the first six months of life suggests an answer. The human infant is more altricial and faces a longer immaturity than any other primate, as is emphasized in the target article. Consequently, the human infant has a need for long-term caregiver investment that dramatically exceeds that of any other primate. The unique topography and richness of human parent-infant face-to-face vocal interactions strongly suggests bonding is at stake (see, e.g., Stern 1974; Trevarthen 1979; Tronick 1982), and that elaborate, contextually flexible infant vocalization solicits parental investment (Oller 2000). Parents appear to distill fitness information from infant vocalization, and in many instances to elicit it in face-to-face interaction, presumably because it benefits parents to make wise decisions about investment of energies in infants facing a long immaturity (Locke, in press c; Oller 2004). Human caregivers also attend to a variety of infant vocalizations outside bonding interactions.

Vocalization in the human infant is then a fitness indicator, providing evidence to caregiving kin about infant well-being. Because the premium on long-term investment by caregivers is higher for the human infant than for any other primate, the selection pressure on infant fitness indicators is also higher than for any other primate. And since altriciality had already increased in hominids by the point of bipedalism, intense selection pressure on infant solicitation of parental investment must have been in place very early in hominid evolution. The pattern of vocal development in the human infant suggests, then, that the driving engine of evolution for hominid vocal capacity may have been the unique constellation of life history circumstances (including altriciality and long immaturity) that encouraged immature hominids to seek caregiver investment, and the hominid parent (and other kin) to seek fitness indications from the infant in vocalization, in order to make better decisions regarding investment of caregiving energies across a long immaturity. This special constellation of forces encouraged parental selection (Locke, in press c) by vocalization assessment, a pattern that may have increasingly resembled sexual selection in its effects on evolution, as the priority on long-term parental investment became increasingly high. Runaway selection (rapidly producing salient new traits) has long been well-recognized as a product of sexual selection (Darwin 1871; see a review in Miller 2000), and it may well be that the elaborate human vocal capacity was spurred on by parental selection in early life of hominid infants. As noted in the target article, this vocal capacity, fostered in infancy through parental selection, could have been amplified in adolescence through sexual selection.

Of course, human parents use (and ancient hominid parents no doubt used) a variety of fitness indicators in making decisions about investment in their young. But vocalization has unique status as a communicative device among birds and mammals. Vocalization in many species communicates immediate survival needs and provides a primary fitness indicator in sexual selection (Hausberger 1997; Hauser 1996; Kroodsma 1999). In humans, vocalization appears to play a significant role in sexual selection (Miller 2000), but also a critical role in survival during the most altricial period of infancy. The importance of this early altricial period in fostering the creation of vocal capabilities that have a foundational character for language has been vastly underplayed in most prior portrayals of language evolution, where the focus has so often been on how syntax in language came about (see, e.g., Bickerton 1981; Pinker & Bloom 1990). Syntax, and many precursors to it, could never have occurred without fundamental communicative flexibility; and syntax is a feature of language that appears in the human infant only after many months of infrastructural development in flexibility of vocal communication. The target article is on the mark in highlighting the life history issue. The necessary refocusing on developmental issues in speculations about language evolution will inevitably bring us to the beginning of hominid evolution and thus to the beginning of vocal development in the first months of human life.

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Comparative, continuity, and computational evidence in evolutionary theory: Predictive evidence versus productive evidence

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Abstract: Of three types of evidence available to evolution theorists – comparative, continuity, and computational – the first is largely productive rather than predictive. Although comparison between extant species or languages is possible and can be suggestive of evolutionary processes, leading to theory development, comparison with extinct species and languages seems necessary for validation. Continuity and computational evidence provide the best opportunities for supporting predictions.

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