first and grammar bootstrapped off it. There is evidence that here ontogeny also may recapitulate phylogeny (Peters 1983; Wong Fillmore 1976).

In terms of mental storage and retrieval it is also clear that at least some of the phrasal lexicon and that part of the one-word lexicon which has associated conditions of use are right hemispherical, whereas analytic and synthetic linguistic capacities are generally left hemispherical (Van Lancker 1987; Wray 2002).

From crying to words: Unique or multilevel selective pressures?

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Abstract: In the first year of life, infants' utterances change from high-intensity crying to low-intensity acoustic sound strings, acoustically labelling the first word. This transition implies: (1) decoding of phonetic sounds, (2) encoding of phonetic sounds, and (3) a unique linking of an articulated sound to a specific object. Comparative, ontogenetic, and phylogenetic aspects are considered for multilevel selective pressures.

In the first year of life, a human infant's sound emission changes from crying, a high-intensity mammalian signal (Lenti Boero 1997), to low-intensity sound strings having a referential meaning (i.e., words). Semantics comes earlier in ontogeny than grammar and syntax, and constitutes the bricks on which subsequent language competence is built. Between the two extremes of high-intensity crying and low-intensity speech, we find early sound making: a pleasant, musical, rewarding signal for both infant and mother (de Boysson-Bardie 2001; Papoušek & Papoušek 1981; Ruzza et al. 2003). The transition from early crying to the first meaningful word implies the existence of the following competencies:

1. Decoding of phonetic sounds (perceptual)
2. Encoding of phonetic sounds (articulation and motor)
3. Linking univocally an articulated sound to a specific object (cognitive).

It is important to underscore that language includes both perceptual decoding and motor encoding components, as earliest clinical studies by Broca and Wernicke showed (Ellis & Young 1988).

Language ontogeny in the first year of life implies separate decoding and encoding competencies. In human communication artefacts (e.g., human communication engineered products, like telephones, where, in the same object, both encoding and decoding devices are designed at the same time by the human maker [who is not blind]) decoding and encoding features coevolve, but this might not be the same for language. (It is important to contrast human design and natural selection's design, and underscore the independence of decoding and encoding language features.) In fact, the above-mentioned three competencies might have different selective pressures.

Referential competence is defined as the ability to identify objects by means of an icon (acoustic or visual). Earlier studies on apes' language have shown that even the nearest apes cannot articulate human-like sounds because of the lack of articulation space and nervous motor control of the larynx (Lieberman et al. 1969; Ploog 1992); however, apes are very competent in referring objects to tokens or human gestures. Other mammals have been shown to utter species-specific sounds related to predators (Cheney & Seyfarth 1990; Lenti Boero 1992), to understand human words relative to objects (Kaminski et al. 2004), and to discriminate phonetic sounds (Miller 1977; Morse & Snowdon 1975). Thus, from mammalian studies we deduce that competencies 1 and 3 are present (many more examples can be given), but competency 2 is lacking.

Studies on songbirds have proposed that they should be considered interesting models for human language because of their ability to articulate strings of sounds and to crystallize species-specific songs heard in the social environment, a process similar to the one that human infants undergo in the transition from crying, through early sound making, to correct articulation of the first word (Hultsch & Todt 2004).

Songbirds have competencies 1 and 2, but completely lack competency 3. Among birds, parrots (in particular, the Gray parrot) are a unique species in this respect, having, like humans, all three competencies (Pepperberg 1981; 1983). However, competency 3 is used only in animal-human interactions, analogously as among apes, suggesting that parrots and apes do not spontaneously generate socially shared referential systems – *apparently* a unique human competency (but see Savage-Rumbaugh et al. 1996). If all those competencies appear separately among vertebrates, they must have different selective pressures.

In the first month of life, the human infant shows competency 1 (Mehler et al. 1988), but does not show competency 2. (If proper experiments have not yet been done to explore competency 3, these will certainly come later on.) Did competency 1 undergo selective pressure, and, if so, from which agents? Perception and discrimination of phonetic sounds cannot be early selected by parents, being concealed to them, and can be disclosed only with proper experiments and selected for if and only if eventually related to further sounds and babbling emission.

The above-mentioned studies on song learning in songbirds suggest the existence in a vertebrate species of an inner motor learning module, expressing itself in future phases. In humans, the full expression of native language sounds might be postponed by the immaturity of the articulation and nervous motor control component. If perception and discrimination of phonetic sounds do not relate to later sound-making and babbling, we should think of selective pressures independent from parental selection. One possibility is that those competencies are a by-product of a more widespread and general cognitive module referring to analysis of acoustic scene performed in the natural environment. The fact that other mammalian and bird species are able to discriminate human phonetic sounds, and that Gray parrots are able to decode and discriminate musical notes from the temperate scale, might support this hypothesis (Bottoni et al. 2004). With regard to competency 2, it is important to underscore that humans are the only mammalian species endowed with an articulation apparatus allowing the emission of quasi-musical sounds that, as Locke & Bogin (L&B) correctly state, have been selected by parental pressures. This apparatus is the foundation of vowel emission (Titze 1994), and, together with an improved (in respect to apes) tongue and buccal control, it lies behind the ability to articulate early music-like sounds and more refined later phonetic sounds.

This articulation process is allowed by the descent of larynx in the neck, losing contact with the naso-pharynx (we are unique amongst mammalian species in this regard). In order to understand human language as we know it, a key point should be to question how and why this happened. Camperio Ciani and Chiarelli (1988), investigating the physiology of bone deposition and reallocation process in the cranium during ontogeny, suggest that larynx descent is a by-product of the systemic morphofunctional adjustments to include a large prefrontal cortex in the braincase. In the course of hominid phylogeny, larynx descent should have happened gradually; we might speculate of an hominid phase during which vocal communication was no longer built of fixed mammalian-like sounds but was not yet

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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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