Against this, I offer the hypothesis that syntax is more a cultural than a biological phenomenon – and therefore speak of a *language-ready brain* as one that can acquire language in a modern human society, while denying than human brains have syntax "biologically precoded."

2.5. Sign languages invented by the deaf have all the essential properties of spoken language, including a sophisticated syntax.

Indeed. But it may be asked whether full sign language was a necessary precursor to spoken language or whether an Expanding Spiral of protosign and protospeech provided early *Homo sapiens* with a language-readiness that fell short of full language, signed or spoken. In many cases, "full" sign languages reflect, in part, the attempt of deaf people to import the richness of spoken or written language back into sign.

2.5. Syntax could have emerged from the structure of individual gestures themselves.

In similar vein, Stokoe (2001; continuing the quote from Stokoe above) asserts that: "The gesture also has . . . syntax because the hand for the person and its movement telling what she did are subject and predicate (or noun phrase [NP] + verb phrase [VP])."

I think this is a mistake. It is true that a linguist can *sometimes* dub the hand shape of a sign as denoting an object and the movement of the hand as denoting an action, but these are not necessarily separable. And if they are not separated, they do not need syntax to put them together again. It is only the *translation* to, for example, English that has this syntax. Moreover, *airplane* is signed in ASL with tiny repeated movements of a specific handshape, while *fly* is signed by moving the same handshape along a trajectory (Supalla & Newport 1978). Here, both verb and noun combine handshape and motion. For me, the import of the airplane/fly distinction is that, while a "natural" gesture is unitary, extending the range of discourse requires distinctions that cannot be mimed directly. Thus, early humans might have developed a natural pantomime which stood equally for "a bird is flying," "the flying bird," "flying," or "bird" – relying on the "listener" to interpret the sign correctly in context. As it became useful to distinguish these meanings, a community had to develop conventions to mark them, initiating the transition from pantomime to a conventionalized system of signed communication (Arbib 2003b).

3.1. Facial gestures generally convey syntax, whereas manual gestures supply content, suggesting a progression from manual to facial gesture in the emergence of language.

The first statement is false, thus invalidating the second. Emmorey et al. (2002, Fig. 1) show how a sequence of hand movements may employ classifier constructions to express spatial syntax. But note, too, that signers make fuller use of the facial musculature than speakers do. Is this because protosign evolved the appropriate muscle control, or because signers can exploit a more generic human capacity for fractionation of motor skills? Recent modeling of the development of manual skills seems to suggest the latter (Oztop et al. 2003). And consider learning to play the piano (surely not part of the experience of early *Homo*!) – with its cumulative mastery of finger exercises and the hierarchical progression from note to chord to phrase and on to syncopation.

3.1. The next step may have been to add voicing.

Since other primates have vocalization, we can expect that some voicing was always present. I suggest that the development of conventionalized gestures in protosign, rather than any syntactic structure in sign, provided the "evolutionary drive" for the development of a rich protospeech and the concomitant neural apparatus to control the articulators. The Expanding Spiral then allowed the expressiveness of protosign and protospeech to feed off each other to yield the evolution of the language-ready brain. By contrast, I find the frame/content theory of MacNeilage (1998) unconvincing because it grounds the syllable in mastication with no indication of how evolving modes of communication could provide the selection pressure for relevant changes in the articulators and their neural control.

3.3. In view of the longstanding involvement of Broca's area in manual activity, its enlargement in Homo habilis, *nearly two million years ago, may reflect the incorporation of syntax into gestural communication.*

Again, why posit syntax this early? The switch from a closed repertoire to the ability to create, learn, and use an open set of holophrastic utterances would possibly have been enough for this. The stasis of tool use in *Homo habilis* argues for a long period of stasis in protolanguage (cf. Noble & Davidson 1996), which might be more consistent with a limited stock of holophrastic utterances than with a flexible syntax. This would seem to accord better with Corballis's later statement (sect. 3.6) that autonomous speech may have emerged gradually in Africa over the period from 170,000 to 50,000 years ago. I would suggest that language (as distinct from protolanguage) and rich systems of syntax also emerged, postbiologically, during this period.

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Is gestural communication more sophisticated than vocal communication in wild chimpanzees?

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Abstract: The communicative behavior of chimpanzees has been cited in support of the hypothesis that language evolved from gesture. In this commentary, I compare gestural and vocal communication in wild chimpanzees. Because the use of gesture in wild chimpanzees is limited, whereas their vocal behavior is relatively complex, I argue that wild chimpanzee behavior fails to support the gestural origins hypothesis.

Corballis argues that manual gesturing was the mediating factor in the evolution of handedness in humans. As he points out in the conclusion of his article, the key issue in his argument, therefore, is whether language evolved from gesture. To support the gestural origins hypothesis, Corballis uses the communicative behavior of wild chimpanzees to speculate about the communicative repertoire of a human/chimp common ancestor. He concludes that wild chimpanzee gestural communication provides a more plausible hypothetical substrate for the evolution of an intentional communication system than chimpanzee vocal communication does. In this commentary, I will compare what is known about gestural and vocal communication in wild chimpanzees. Leaving aside the significant problems associated with using modern apes to model the behavior of human ancestors (Marks 2002), I will argue that Corballis has overestimated the role of gestural communication in wild chimpanzee interactions while simultaneously underestimating the complexity of their vocal behavior. I suggest that wild chimpanzees offer little support for the idea that language evolved from a structured system of gesture, or, by extension, that manual gesture led to handedness.

Is it true, as asserted in section 2.1, that "chimpanzees and other apes make extensive use of gestures in the wild"? In an effort to support this claim, Corballis reviews three different studies of *captive* apes: de Waal (1982) and Tomasello et al. (1997) on chimpanzees, and Tanner and Byrne (1996) on gorillas. However, the behavior of captives, who are influenced by human caretakers and artificial environments, is irrelevant here. Moreover, published reports of wild chimpanzee behavior do not support Corballis's representation of wild chimpanzee gestural communication. In Table 1, I have listed the gestures so far documented for wild chimpanzee communicative interactions. The evidence to date shows clearly that wild chimpanzees rarely use manual gestures, and that the vast majority of gestures they do use are employed in the context of

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Table 1 (Arcadi). *Gestures documented in wild chimpanzee communicative interactions*[1]

Name	Type	Context
Compressed-lips face	Facial	Aggression
Sneer	Facial	Fear/threat
Full open grin	Facial	Fear/excitement
Low closed grin	Facial	Fear/excitement
Full closed grin	Facial	Fear/excitement
Horizontal pout	Facial	Distress
Pout	Facial	Distress
Head tip	Postural	Aggression
Sitting hunch	Postural	Aggression
Quadrupedal hunch	Postural	Aggression
Swaying branches	Object manipulation	Aggression
Throwing	Object manipulation	Aggression
Flailing (stick)	Object manipulation	Aggression
Drag branch	Object manipulation	Aggression
Bipedal swagger	Locomotion	Aggression
Running upright	Locomotion	Aggression
Charging	Locomotion	Aggression
Arm raise	Manual	Aggression
Hitting toward, flapping	Manual	Aggression
Presenting	Postural	Submission
Crouching, bowing	Postural	Submission
Bobbing	Postural	Submission
Bending away	Postural	Submission
Kissing	Body contact	Submission
Embracing	Body contact	Submission
Mounting	Body contact	Submission
Reaching toward with palm up	Manual	Submission
Offering back of wrist	Manual	Submission
Branching	Object manipulation	Attention-getting – sex
Leaf clipping	Object manipulation	Attention-getting – sex
Leaf grooming	Object manipulation	Attention-getting – grooming
Arm high	Manual	Attention-getting – grooming
Arm high	Manual	Appeasement
Play start	Object manipulation	Attention-getting – play
Pointing	Manual	Draw attention to

[1]The majority of these behaviors were first described by Goodall (1968; 1986). Nishida (1980) described leaf clipping; Plooij (1978) described arm high; Vèa and Sabater-Pi (1998) observed a single young adult male bonobo point three times; Inoue-Nakamura and Matsuzawa (1997) observed an infant chimpanzee point once.

dominance interactions. Indeed, the repertoire of gestures chimpanzees use to mediate aggressive conflicts appears unexceptional when compared with those of similarly social species with frequent status interactions (e.g., canids: Harrington & Mech 1978; Lehner 1978). Beyond the mostly facial and postural gestures used in agonistic contexts, wild chimpanzees occasionally use a small number of attention-getting gestures that solicit physical approach, but do not elicit communicative responses, in receivers. The most interesting gesture from the point of view of the gestural origins hypothesis – pointing – has been observed just once, and that in an infant, in tens of thousands of hours of wild chimpanzee observational research at many field sites across the species range.

While overstating the complexity of gestural communication among wild chimpanzees, Corballis also downplays the complexity of wild chimpanzee vocal behavior by emphasizing its dependence on emotional state. However, although it seems clear that chimpanzee vocalizations are tightly linked to emotional state, this is apparently also true of many of their gestures, as revealed by reports of attempts to conceal uncontrollable facial expressions (de Waal 1982; Goodall 1986). In addition, chimpanzees do have some control over vocal production; they can suppress calls in some contexts (e.g., during territorial patrols: Goodall 1986; when raiding village crops: personal observation), and they can modify call structure to a greater degree than has been observed in other primate species (Arcadi 1996; Arcadi et al. 1998; Mitani & Brandt 1994; Mitani et al. 1992; 1999). And finally, it is clearly not the case, as asserted in section 2.1, that chimpanzee vocalizations "are typically not directed to specific others." Of the 15 chimpanzee vocalizations defined acoustically by Marler and Tenaza (1977), at least eight of them (cough, scream, squeak, whimper or hoo series, hoo, pant, pant grunt, and pant hoot) are directed at specific individuals with whom the vocalizers are interacting (Goodall 1986; Hayaki 1990), and one of these (pant hoot) is frequently used in long-distance calling exchanges, probably with known individuals (Arcadi 2000; Mitani & Nishida 1993).

In part based on his interpretation of wild chimpanzee behavior, Corballis concludes that gestures came under voluntary control before vocalizations in a population of human ancestors. But current research on wild chimpanzees offers no obvious justification for this hypothetical order of events. In the absence of human influence, nothing chimpanzees do vocally or manually bears much resemblance to language or to modern human gestural communication (Arcadi 2000). Consequently, the evidence from chimpanzees does not make a compelling case to eliminate the alternative and simpler evolutionary hypothesis, that is, that vocalizations came under voluntary control through selective pressures on an already variable and possibly socially influenced vocal repertoire (Arcadi 1996; Marshall et al. 1999; Mitani & Brandt 1994; Mitani et al. 1992; 1999), and that the integration of manual gestures into linguistic interactions evolved during or after this process.

Creative solution to an old problem

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Abstract: Corballis presents a plausible evolutionary mechanism to explain the tight linkage between cerebral lateralization for language and for handedness in humans. This argument may be bolstered by invoking Stokoe's notion of *semantic phonology* to explain the role of Broca's area in grammatical functions.

Corballis seems to have hit on something here. There has been no lack of speculation about the ontogeny and phylogeny of human cerebral lateralization. However, the arguments for why both handedness and lateralization for speech production and perception should be associated with the left cerebral hemisphere have

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