A biological infrastructure for communication underlies the cultural evolution of languages

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Abstract: Universal Grammar (UG) is indeed evolutionarily implausible. But if languages are just "adapted" to a large primate brain, it is hard to see why other primates do not have complex languages. The answer is that humans have evolved a specialized and uniquely human cognitive architecture, whose main function is to compute mappings between arbitrary signals and communicative intentions. This underlies the development of language in the human species.

Christiansen & Chater (C&C) correctly pinpoint a number of serious problems for a detailed, innate Universal Grammar (UG). Language turns out to be, after all, just a part of culture, participating in all the associated processes of twin-track co-evolution (Durham 1991), including the cognitive filtering of possible cultural products (Levinson & Jaisson 2006). Recent work shows just how grammatical features are subject to cultural evolutionary processes (Dunn et al. 2005).

However, we should avoid throwing out the proverbial baby with the bathwater: There is a biological basis for language in two areas at least. First, the input/output systems (auditory specializations, vocal anatomy) clearly involve biological evolution (Lieberman & Blumstein 1988). Second – and this is the subject of this commentary – there is an underlying cognitive infrastructure for human communication. To see this, consider the conundrum the target article authors now face. Most properties of the human brain are just enlarged versions of ancient structures shared throughout the primate order and beyond. Our nearest cousins, the two chimp species, are highly intelligent animals that can master most human tasks not mediated by language (Tomasello & Call 1997). So how come they do not have the kinds of elaborate communicative systems we call language?

The answer to this, we think, is that humans have inherited a cognitive infrastructure for communication that probably goes way back in the hominin line. This infrastructure is perhaps correlated with the increasing encephalization characteristic of hominin evolution, the characteristic that makes language possible.

We agree with C&C that these prerequisites for the emergence of language are not to be found in the structural properties of languages themselves. However, contra C&C, we believe that they cannot be found in the "accidental" properties of our general cognitive abilities either. Instead, we propose that humans have developed what we would quite generally term communicative intelligence (see Enfield & Levinson 2006). The main function of this specific type of intelligence is to encode and decode the communicative intentions behind any type of potentially communicative behavior, linguistic, nonverbal, or otherwise (e.g., gestures). Without such specialized structures, the speed and flexibility with which language (in multiple modalities) is used, learned, and changed, even within one generation, would not be possible.

Empirical evidence for our assumption comes from the following findings.

A. Even for adults who have fully mastered their native language(s), linguistic signals are abundantly ambiguous and underdetermined. The idea that thoughts are encoded into linguistic utterances, sent to a receiver through a medium such asvoice or hands, and then are decoded back into the original thought – a naive idea that has been endorsed by many scientists, from Saussure to Shannon – can and has repeatedly been shown to be false (see Levinson 1983; 2000 for multitudes of examples and further references). There is therefore a fundamental mismatch between coded content and communicative import, and the gap is filled by reasoning about likely communicative intentions. The upshot here is that it is not language that enables us to communicate; rather, it is our communicative skills that enabled us to use language.

B. Many systematic "errors" that at first sight appear to be cognitive "limitations" of humans, are in fact highly functional in the context of human communication (Levinson 1995). Key among these is the tendency to attribute intentional design to natural objects, events, and processes, with all the attendant irrationalities of magic, superstition, religion, and gambling. But that tendency is exactly what is needed to understand complex communicative signals, where one has to work out the communicative intention behind them. The ability to "read" these signals appears to carry with it the overdeterminative interpretations of events that are characteristic of human reasoning (Tversky & Kahneman 1977).

C. Languages are independent of sensory modality, as shown in human haptic or sign languages (Emmorey 2002). These gestural languages can develop from scratch in cultures (Senghas & Coppola 2001) and even in families (Goldin-Meadow 2005). Comparing this rapid development of systems of form-meaning mappings with the enormous efforts involved in getting intelligent species of mammals to communicate using language (see, e.g., Herman et al. 1984; Savage-Rumbaugh 1984) provides strong support for the existence of innate communicative capacities in humans.

D. Human communication is amazingly flexible and effective even in the absence of a shared, conventional language. Several recent studies have shown that participants who are confronted with the need to communicate, but have only limited and previously unknown channels at their disposal, are able to develop new signal-to-meaning mappings on the fly, within a matter of minutes (De Ruiter et al. 2007; Galantucci 2005). De Ruiter et al. have shown that in performing these types of tasks, both senders and receivers of signals show activation in the same small and well-defined brain region, suggesting that senders and receivers simulate one another's inferential processes in order to achieve successful communication.

The evolution of language becomes much less mysterious when this communicative or pragmatic infrastructure is given its proper place. This cognitive infrastructure has evolved slowly over the six million years of separation from our nearest primate relatives, is shared by all humans, and is invariant across all human languages (Levinson 2006). Languages are not adapted to just any primate brain – they are created and filtered by brains that are biologically endowed with communicative intelligence. Together with the vocal/auditory apparatus, this cognitive adaptation for communication makes possible the cultural evolution of spoken languages.