A shrug is not a sentence

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Abstract: Corballis's claim that the origin of syntax lies in solely gesture is contested. His scenario does not explain why constraints on syntactic "movement" are apparently part of the human biological endowment for language. It also does not pay enough attention to the internal structure of sentences, and how they contrast with other linguistic units such as noun phrases.

Michael Corballis's scenario raises fascinating questions for physiologists and neurologists. I will concentrate here on three linguistic points, the last being the most important.

Corballis's use of the term *voicing* is odd. It is true, as he says in section 3.2, that [p], [t], and [k] are in many languages distinguished from another series of plosives, [b], [d], and [g], by voicing, in that the vocal folds vibrate during the production of the latter but not the former. But that is not the main way in which the so-called *voiceless* and *voiced* stops are distinguished in English, as it happens (more important factors are voice onset time in following vowels and the length of preceding ones). Besides, there are many languages in which contrastive voicing plays no role at all; that is, vibration of the vocal folds is entirely predictable (vowels, liquids, and nasals being voiced and plosives being usually voiceless). But that does not mean that in those languages the vocal folds are redundant. Consonantal place of articulation is signalled acoustically by formant characteristics of neighbouring vowels, even when the consonant itself is voiceless. So adding vocal fold vibration to facial gesture (if that is what happened) would have served mainly not to increase the repertoire of consonant sounds, but rather to increase their audibility at a distance and in particular to render them auditorily more distinct.

In section 2.5, Corballis argues that the origin of syntax can be traced to iconic gesturing. Different aspects of syntax almost certainly originated at different times and in different ways; but at least some of those aspects that belong to our biological endowment (rather than our cultural environment) more probably originated at a time when language was primarily spoken rather than signed, I think. Consider the sentences *When did the boy say he hurt himself?* and *When did the boy say how he hurt himself?* The first is ambiguous (it may relate to the time of the boy's injury or the time of his statement), whereas the latter is not (it can relate only to the time of the boy's statement). This is apparently not a cultural fact, relating to the English language in particular, because it is not something that children learning English natively make mistakes about (like saying *bringed* or *brung* for *brought*, for example). Yet, there is nothing semantically odd about interpreting the second sentence as relating to the time of the injury. Indeed, that interpretation is available to the variant of it, without "WH-movement," that conveys incredulity ("Surely my ears deceived me!"): *The boy said how he hurt himself WHEN?!* Why this discrepancy between the two sentences? It seems to have to do with constraints on the sort of "movement" that transports question-words such as *when* and *how* to the beginning of the clause in English. This relates to the gestural origin theory as follows. It is not clear whether syntactic movement plays such a large part in sign languages as in spoken languages. Indeed, it is understandable why it should not: some manual signs can be superimposed on one another, or made simultaneously, whereas spoken words cannot be superimposed in an utterance. The role of linear order is thus somewhat different in the two kinds of language. So, because that part of the human endowment for syntax which rules out one conceivable interpretation of the *When . . . how . . .* sentence seems crucially to do with constraints on reordering, it seems unlikely to have originated at a stage when language was mainly gestural (even if such a stage existed).

Corballis bases his belief in a gestural origin for syntax on suggestions by Armstrong et al. (1995). He says (sect. 2.5): "there are many gestures in common use that can be understood as a simple sentence, such as the shrug, or the dismissive wave of the hands that says, in effect, 'forget it.'" But what makes a sentence a sentence, (e.g., *Columbus discovered America*) rather than, say, a noun phrase (e.g., *Columbus's discovery of America*) is not its meaning but its internal structure. It is true that some sentences in some languages consist of a single word, and in that sense lack structure. But that is the exception rather than the norm. The gesture of grasping the left forefinger with the right hand does indeed have a structure that can be interpreted as sentence-like, but many other gestures do not – including the shrug. That is the flaw in Armstrong et al.'s scenario for the origin of syntax (Carstairs-McCarthy 1996). Indeed, it is precisely the lack of structure in the Neapolitan equivalent of the shrug that, according to one famous anecdote (Malcolm 1958, p. 69), persuaded the philosopher Wittgenstein that the analysis of "propositions" proposed in his *Tractatus Logico-Philosophicus* was on the wrong track.

What research on language evolution urgently needs is input from experts on the grammar of sign language. It is they who can comment most expertly on whether or not any biologically fixed characteristics of syntax-as-it-is, spoken as well as signed, can plausibly be seen as the residue of a predominantly gestural stage. Sign language experts may be reluctant to become involved in this area because it hints at the possibility that sign languages are different from spoken ones in a fundamental fashion that is not purely attributable to the medium – which in turn hints at the discredited notion that sign languages are inferior. However, difference does not imply inferiority. It may be that some of the poor design features of spoken language grammar (and poor design features certainly exist!) are attributable to an origin in something other than gesture (namely, the structure of the syllable in the phonology of spoken languages), and it may even be that contemporary sign languages lack some of these poor design features simply because deaf children are not exposed to spoken syllables (Carstairs-McCarthy 1999).

Vocalisation and the development of hand preference

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Abstract: What do the relationships observed in the occurrence of various limb, facial, and speech apraxias following left hemisphere damage mean for Corballis's theory? What does the right hemisphere's role in non-propositional and automatic speech production tell us about the coevolution of right hand preference and speech; how could the possibility that the right hemisphere may be "dominant" for some aspects of speech be accommodated by his theory?

We have supposed an evolutionary relationship between speech and handedness for a long time, as Corballis points out, but for many theorists the causality went the other way – from early gestural communication to the development of speech. Surprisingly, perhaps, Corballis does not discuss the relevance of apraxias to his interesting theory. One hundred and fifty years of lesion data suggests that both action- and gesture-processing and speech production are predominantly left hemisphere responsibilities. Impairments to the action system, causing a range of apraxias, are a common consequence of prefrontal and parietal left hemisphere damage, and different types of apraxia – limb, speech, buccofacial – commonly co-occur (but also dissociate), further supporting a close phylogenic relationship. Since the time of Liepmann, apraxia of speech has been seen as a variant of limb-kinetic apraxia. Liep-

mann (1913/1979) suggested that "the word 'limb' here, refers to the tongue, palate, and oral mechanism" (p. 56). In the same tradition, Kimura (1976; 1982; Kimura & Archibald 1974) proposed that the reason for the apparent close relationship between speech and praxic impairment is explained with reference to the finding that speech processing is highly dependent on praxic skills, and that the development of the capacity to speak is built on a phylogenically earlier capacity for action and gesture. Corballis recognises the relationship but sees the causality running in the opposite direction. First there was vocalisation, then gestural communication developed to augment that. A left hemisphere dominance for vocalisation and gesture, the latter controlled by Broca's area, gave rise over time to right hand dominance for the great majority of us. This contrasts with Rizzolatti and Arbib's (1998; see also Arbib, submitted) scenario based on mirror neurone research, which sees vocalisation and gestural communication as essentially separate before the development of speech (which they see also as coming predominantly from a preexisting capacity for gestural communication based on Broca's area). Arbib (submitted) points to the marked relative anatomical distance between the *vocal* anterior cingulate and a *gestural* Broca's area as supporting this view.

A further issue not considered in Corballis's target article is the role of the right hemisphere in speech encoding; both hemispheres are engaged in language processing, and even in speech encoding. While it is clear that the left hemisphere is the most important for the mediation of speech encoding, there is a range of evidence from imaging studies and brain damage that the right hemisphere is engaged for most of us in at least the nonpropositional, holistic, emotional, and automatic aspects of speech encoding (Code 1997), and may be dominant for these aspects. Studies of aphasic speech automatisms (Code 1994) and the remaining speech of adults who have undergone left hemispherectomy (Code 1996; 1997) provide evidence for right hemisphere engagement in nonpropositional, emotional, and automatic aspects of speech production.

Early studies using regional cerebral bloodflow during automatic counting (Ingvar & Schwartz 1974; Larsen et al. 1978; Skinhoj & Larsen 1980) and recent positron emission tomography scanning during repetition (e.g., Cowell et al. 2000; Wise et al. 1999) show that the right hemisphere is active during automatic and repetitive speech. Larsen et al. (1978) found no significant differences between right and left hemispheres during automatic counting in 18 right-handed volunteers. Bloodflow was predominantly in the upper premotor and sensorimotor mouth areas and the auditory areas of the temporal lobes, with no significant activation of Broca's areas on either side. More recently, Ryding et al. (1987) examined 15 nonaphasic right-handed volunteers reciting the days of the week and humming a nursery rhyme with a closed mouth. Significantly more activity was observed in the right than left hemisphere during automatic speech, but not for humming, which showed equal bilateral activation. Ryding et al. suggest a left hemisphere control for motoric control of speech but right hemisphere control of vocalisation.

Speedie et al. (1993) described a right-handed Hebrew-French bilingual whose automatic speech was disrupted following haemorrhage involving the right basal ganglia. He was not aphasic but had marked difficulties counting to 20, reciting the Hebrew prayers and blessings before eating that he had recited daily throughout his life, or singing highly familiar songs, although he was able to correctly hum some. His ability to swear and curse was also impaired following the right basal ganglia lesion. This case appears to demonstrate a dissociation between nonpropositional and propositional speech and provide evidence of right hemisphere dominance for automatic and nonpropositional aspects of speech and vocalisation.

This possible right-left dissociation in propositionality in speech may be more prominent in left-handers than right-handers. Using the Wada technique, Milner and associates (Milner 1974; Milner et al. 1966) showed that seven of 17 left-handed (but neurologically impaired) volunteers with bilateral representation for speech production made errors in serial counting forwards and backwards, and reciting the days of the week, following right-side anaesthesia. Following left-side injection they made errors in naming, but not automatic speech. For two other participants in the group, naming errors occurred with right hemisphere anaesthesia and automatic speech errors with left hemisphere injection. Corballis cites the research by Graves and others (e.g., Graves & Potter 1988) on asymmetries in mouth opening during speech. What he did not report was that significantly more left-mouth opening is observed during automatic speech.

Does Corballis's theory predict a possible right hemisphere/left hand engagement in more nonpropositional and automatic aspects of gesture accompanying speech, and in deaf sign language, mirroring the apparent situation for speech production?

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Hemispheric dominance has its origins in the control of the midline organs of speech

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Abstract: Unlike all other lateral specializations, the necessity for unilateral dominance is clear only for the case of the motor control of the speech organs lying on the midline of the body and innervated from both hemispheres. All functional asymmetries are likely to be a consequence of this asymmetry of executive control.

As always, Michael Corballis demonstrates in the target article that he has his finger on all of the important issues in human laterality; but I think that he has built the causality story back-to-front in an effort to upgrade the handedness issue to the level of importance of the cerebral asymmetry for language. The crucial question that he does not address is: Of what possible value (evolutionary significance) could unequal hemispheric capabilities have for *Homo sapiens* – and possibly other species? Although he briefly reviews the literature indicating degrees of laterality in diverse species for diverse tasks, without a fundamental reason why some cortical functions should be asymmetrical, the causality arguments dissolve into a mass of possible scenarios supported by whispers of fossil evidence and unconvincing statistics on captive versus noncaptive monkeys, chimps, and frogs.

The evolutionary argument has been most clearly stated by Passingham (1981). That is, in considering why cerebral lateralization is unambiguously strongest for speech functions, Passingham noted that, unlike all other lateral specializations, there is the potential for real conflict only in the motor control of organs that lie on the midline of the body and are innervated from both hemispheres. In other words, only for motor speech acts is it clear why unilateral cerebral control would have been selected for in evolution. For the hands, there may be some mild advantage to a precision-versus-power or stabilization-versus-execution specialization of the hemispheres, but such a division of labor is empirically rather complex in humans and takes various forms in other species. The presence of similar motor control programs in both hemispheres for the control of the separate hands is theoretically possible and poses no greater problem than one of slightly inefficient cortical storage. As demonstrated by several of the split-brain patients and individuals with callosal agenesis, conflicting commands coming from the two hemispheres can lead to an incoordination where the two hands are not pursuing the same goal; but for the control of the organs of speech in the intact brain, conflicting motor commands sent from both hemispheres to one-and-