through spatial contiguity. That classification is not complete and it is possible to further subdivide conversational gestures according to a range of discourse functions. As far as representational gestures are concerned, recent observations indicate that the performance of this kind of movement relates to the mental activation of motor images (Beattie & Shovelton 2002; Feyereisen & Havard 1999). In that sense, these conversational gestures derive from action and the right hand is probably preferred because it is the dominant hand during interactions with objects, not the other way around.

Gesture laterality varies with gesture form and meaning. The right hand is preferred for performing representational gestures, but no asymmetry is found as far as beat gestures are concerned (Hostetter & Hopkins 2002; unpublished study of Debra Stephens quoted by McNeill 1982, p. 332). Thus, the claim that vocalisation created right-handedness is not true for all types of gestures: The beat gestures are simple, nonfigurative movements that are closely related to speech but are performed by the two hands in the same proportions.

Unilateral brain damages affect gestures and speech in different ways, and in agreement with Corballis's view, left-hemisphere dominance is stronger for language than for manual activity. Left hemispheric stroke patients were found to perform the same amount of conversational gestures as control subjects: fewer right-hand gestures but more left-hand and bilateral gestures (Foundas et al. 1995b). It was concluded that the right hemisphere contributes to the production of speech-related gestures (see also the complex pattern of lateralization described in a split-brain patient by Lausberg et al. 2000). In a picture description task, the rate of representational gesture production was higher in aphasic patients suffering from naming or repetition impairments than in control subjects, or in aphasics suffering from conceptual impairments (Hadar et al. 1998a). This rate of representational gesture production was lower in right-hemisphere patients suffering from visuo-spatial impairments (Hadar et al. 1998b). Therefore, some aspects of speech production (lexical access, phonological encoding) depend on different brain structures from those controlling the production of representational gestures, which entail visuo-spatial processing. Motor and verbal representations may be combined on another, preverbal level, during the conceptualisation of the message.

Combining words and gestures in discourse has a cost, however, and it constitutes a particular instance of dual-task performance. Vocal responses were delayed in a choice reaction time task when a representational or deictic gesture was to be performed concurrently (Feyereisen 1997; Levelt et al. 1985). Similarly, temporal characteristics of speech were altered when manual signs and spoken words were combined in simultaneous communication, a procedure aimed at augmenting the input available to deaf listeners (e.g., Whitehead et al. 1997). Thus, we see that there is competition between the two production systems and there are constraints in the development of a integrated bimodal system. In natural conversations, representational gestures are often performed during silent pauses to reduce such interference.

There are also limits to the combination of words and gestures on a morpho-syntactic level. Unlike manual signs, conversational hand gestures do not display the dual patterning found in spoken language. They are not built from elementary, meaningless units (kinemes) and they do not combine to form larger phrasal units. Nonetheless, in some circumstances, when speakers are prevented from using language to communicate, more complex manual signs can be invented (Goldin-Meadow et al. 1996). Similarly, during language acquisition, there is a transition phase during which hearing children combine a word and a gesture but provide no instances of gesture sequences (e.g., pointing to a bottle of milk and miming the act of drinking: Capirci et al. 1996). The development of vocal communication prevents manual gestures from developing into a full-fledged sign language, as happens in deaf communities. As a result, conversational gestures lack syntactic properties, and it is somewhat difficult to imagine that during evolution, syntax first appeared in a proto-sign language and then disappeared in the manual modality when vocal communication became dominant.

Analyses of conversational gestures in normal and brain-damaged individuals are consistent with the hypothesis of piecemeal evolution of separate components of language and action (Feyereisen 1999). In its broad sense, language use, be it vocal or manual, involves several specialised subsystems, some of which operate on distinct parameters and depend in part on specific brain regions.

ACKNOWLEDGMENT

The author is funded as Research Director by the National Fund for Scientific Research, Belgium.

Unbalanced human apes and syntax

Roger S. Fouts[a] and Gabriel Waters[b]

[a]*Chimpanzee and Human Communication Institute, Central Washington University, Ellensburg, WA 98926-7573;* [b]*Department of Linguistics, University of New Mexico, Albuquerque, NM 87131-1196.* **foutsr@cwu.edu waters@unm.edu www.cwu.edu/~cwuchci/**

Abstract: We propose that the fine discrete movements of the tongue as used in speech are what account for the extreme lateralization in humans, and that handedness is a mere byproduct of tongue use. With regard to syntax, we support the Armstrong et al. (1995) proposition that syntax derives directly from gestural motor movements as opposed to facial expressions.

We will discuss two areas in which we disagree with Corballis with regard to his hypothesis concerning the gestural origin of language. They are: (1) the importance of the tongue in lateralization, and (2) the importance of gesture as the prime mechanism for the evolution of syntax.

With regard to lateralization, Corballis places too much emphasis on handedness. He advances a gestural theory for the origin of language, yet he focuses on vocalization as a driving force for lateralization. It is this focus that perhaps led him astray on two accounts. First, it is possible that the trend toward lateralization for vocalization that Corballis suggests, is merely a side-effect of a general trend toward a lateralization for communication. For example, Hook-Costigan and Rogers (1998) found similar individual tendencies toward lateralization as those reported for group level handedness in primates in the hemi-mouth comparisons of marmosets when making communicative versus emotional vocalization and facial gestures.

Second, when nonhuman apes vocalize they do not move their tongues. However, we humans move our tongues extensively when we speak. The problem is to explain how we evolved from not moving our tongues during vocalizations to doing it all the time. As Corballis suggests, the neurological association between the motor movements of the tongue and hand are close; but even Darwin (1889/1998) saw the critical connection between the fine discrete movements of the hand and sympathetic movements of the tongue. For Hewes (1973b), via Darwin, the solution was that the fine discrete movements of the hand facilitated similar movements, with the tongue, of the type we use during speech. Waters and Fouts (2002) found that such sympathetic movements of the tongue and lips accompany the fine motor manipulations performed by chimpanzees to a greater degree than with gross motor movements. Such research, when coupled with theories regarding basic syllabic frames consisting of lip and tongue movements (MacNeilage 1998), provides a better proposal for basic human phonation. Also, it provides a mechanism for the association and transfer of more complex information across modalities.

Once the tongue started moving during speech, it presented a whole new situation with regard to motor control. The tongue is a single medial organ, and we have two competing hemispheres.

https://doi.org/10.1017/S0140525X03370062 Published online by Cambridge University Press

The hemispherical competition for the control of the tongue eventually is resolved by one hemisphere taking over its sole control. When unresolved, the hemispherical competition can result in stuttering (Jones 1966). The lateralized control of the tongue is what causes humans as a species and as individuals to become hemispherically unbalanced. The tongue is used extensively in speech and is controlled by one cerebral hemisphere. As a result, the controlling hemisphere receives more blood and nutrients, and, like a well-used muscle, becomes larger with regard to dendritic branching and sheer weight of gray matter (Gur et al. 1980). This in turn helps establish that hemisphere as the dominant one, which in turn produces the byproducts of handedness, footedness, and so on. The dominance and accompanying relative increase in gray matter in a particular hemisphere influences the type of cognitive processing at which that hemisphere can excel.

The second major issue concerns Corballis's thesis on syntax, and may actually be more damaging to his proposed timing for the evolution of language and the relationship between the lateralization of handedness. This issue arises with the lateralization of Broca's and Wernicke's areas in extant apes (Cantalupo & Hopkins 2001; Gannon et al. 1998). It is our position that, rather than posing a hindrance to gestural theories of the evolution of language, such evidence would be predicted by a functional analysis of these areas. This would support the hypothesis that the basis of syntax is inherent in holistic gestures.

Corballis suggests that the transfer of modality from manual to vocal gestures is related to the enhancement of holistic gestures by facial gestures in the development of syntax. To the contrary, Armstrong et al. (1995) point out that the development of syntax is inherent in the holistic gestures. This is not to suggest that accompanying facial gestures and vocalizations were not important enhancements to holistic gestures. However, while facial gestures may provide a basis for inflections, much of the basis for syntax is found in the gestures themselves. For example, the assignment of syntactic roles such as object and agent by verbs is more parsimoniously related to the semantic assignment of actor and object by the movement of hands in space. This is further supported by the observations that great ape gestures more often represent actions rather than objects (Plooij 1978; Tanner & Byrne 1996), and by the use of movement by signing chimpanzees to assign who is to give or receive the action (Rimpau et al. 1989).

With regard to the transfer of modality and the role of gesture for the evolution of syntax, the differential grips represented by mirror neurons in the homologue to Broca's area in rhesus monkeys take on more significance (Rizzolatti & Arbib 1998). These grips serve both as a mechanism for shaping vocalizations that accompany gestures, and as a neurological representation of the component parts of a holistic gesture. Furthermore, lateralization of Wernicke's area in the nonhuman apes, which functions in the prediction of visual sequences (Bischoff-Grethe et al. 2000), provides a mechanism for parsing the components of a holistic gesture (Fouts & Waters 2001). The result is a gestural origin of language that includes neurological continuity and functional relevance to data from extant apes. (For a more detailed explanation, see Fouts 1987; Fouts & Mills 1997; Fouts & Waters 2001; and Waters & Fouts 2002.)

A functional account of the neurological structures involved in language use, which takes into account behaviors of extant apes, suggests that the lateralization of these structures should not be treated as information to be explained away but rather central to a gestural theory of the evolution of language. If these structures are integral to the foundation of syntax, then handedness may be the effect of the push toward the use of a medial organ for a function that originated with the movement of objects (hands) in space, or a general push toward a left lateralization for communication. In either situation, Corballis has reiterated that the variability and genetic effects of handedness are available for selection; however, we believe that to raise the evolution of handedness and language above the rank of an interesting coincidence requires greater attention to comparative behavioral research and linguistic theory than is presented in the target article.

Work and talk – handedness and the stuff of life

Grant. R. Gillett

University of Otago Medical School, Dunedin, New Zealand.
grant.gillett@stonebow.otago.ac.nz

Abstract: Wittgenstein shifted from a picture theory of meaning to a use-based theory of meaning in his philosophical work on language. The latter picture is deeply congenial to the view that language and the use of our hands in practical activity are closely related. Wittgenstein's theory therefore offers philosophical support for Corballis's suggestion that the development of spoken language is the basis of dominance phenomena.

Wittgenstein, one of the most significant philosophers of language of the twentieth century, underwent a metamorphosis in his understanding of language and thought which was apparently triggered by a conversation with Piero Sraffa, a Marxist economist. Sraffa made a Neapolitan gesture of brushing his chin with his fingertips, asking: "What is the logical form of that?" (Monk 1990, p. 261). Understanding the momentous nature of this exchange takes us to the heart of issues in the philosophy of language that are directly relevant to Corballis's proposal.

The early Wittgenstein championed an idea that has been dominant in contemporary Anglo-American philosophy of language: that language (and thought) incorporate a structured picture of the world made of elements that represent the things around us. This implies that an analysis of the logical structure of a sentence (or corresponding proposition) in combination with a lexicon relating its semantic units to features of the world reveals the meaning of that sentence (or the content of the proposition). The theory derives largely from Gottlob Frege, who argued that the propositional content of any utterance can be obtained by analysing it in the light of its semantic relationship to conditions in the environment ("truth conditions") and the way that they are combined grammatically (e.g., Frege 1977). The implication for cognitive psychology is that a complex computational mechanism working with semantic units and a quasi-mathematical syntactic structure can yield a meaning (or a small set of candidate meanings to be disambiguated on pragmatic grounds) for any utterance. On this account, language has a compositional semantics and a formal or computational grammar. Chomsky, Fodor, Pinker, and all the classical representational theorists work with some derivative of this theory.

The early Wittgenstein, preoccupied with the connection between language and reality, worked out this picture theory of meaning on the basis of Frege's work and its fundamental realist orientation. His own work was taken to imply that all meaningful propositions were either pictures of states of affairs in the world or had some other function quite apart from representation (such as expressing a feeling). Truth and falsity could be assigned to genuine propositions (or pictures of the world) only on the basis of their correspondence, or otherwise, with reality. Language, or at least its representational core, on this account was independent of the world, and sentences could be mapped onto states of affairs in the world by a set of ordered pairs of semantic units and their referents (or, for Tarski, well-formed sentences and sets of truth conditions). Understanding language involved a kind of cognitive calculus deployed in relation to utterances, written or spoken.

Sraffa's gesture had a different pedigree. Marxist theory stressed the link between language and praxis (Marx & Engels 1939). Language was not an abstract picture of the world composed by those with the leisure for intellectual contemplation of their surroundings; rather, it was practical and sprang from work, actual physical involvement with the stuff of life. Language was for

https://doi.org/10.1017/S0140525X03370062 Published online by Cambridge University Press