

new ways of living. It must be stressed (as always) that the behavioural changes that accompanied the evolution of anatomically modern humans were multifaceted and not merely to do with tool making. If Corballis wishes to make the case that the *mode* of language alone completed the process of human cognitive evolution, then he must explain why it led to the whole suite of changes – art, symbolism, the inclusion of grave goods in burial contexts, trade, use of new raw materials, and increasing transport of raw materials, to name just a few – that accompany the evolution of anatomically modern humans.

Having said all of this, Corballis's proposal is intriguing enough for me to want to have a go at enhancing it to lift it above these problems. I begin by seeing two interesting questions arising from what Corballis argued. First, it may be asked how the transmission of knowledge *does* take place in these societies, and second, it may be asked what people *do* talk about during manufacturing sessions if they are not talking about the manufacturing process itself. I believe that both these questions have the same answer: People tell stories. That is, in at least a number of hunter-gatherer societies, knowledge is transmitted indirectly through narrative descriptions of events. This occurs in the Yup'ik of the Western Alaskan coast (Morrow 1990), it occurs in the Northern Dene of the Canadian Subarctic (Christian 1977), and it occurs in the !Kung (Gardner 2002). The !Kung, for example, spend much of their time conversing – not instructing – while they make tools and gifts to serve their elaborate hxaro system of mutual reciprocity (Wiessner 1982). They make their tools slowly and talk quickly. Members of these groups may be unwilling to provide instruction but they are much more willing to produce narrative accounts of their experience, and these accounts provide a vehicle for the transmission of knowledge. These narrative descriptions are not produced *specifically* to transmit knowledge, they are produced because of a more general human tendency to think and talk in terms of narrative.

The question which then arises is this: Why did humans start telling stories? Well, here I can do no better than offer Corballis some of his previous work. In a 1997 paper (Suddendorf & Corballis 1997), Corballis introduced to scholars of evolution the concept of episodic memory. Episodic memory is autobiographical, containing records of our past experiences. It includes such things as the events, people, and things that we have personally encountered. They are crucially related to a particular place and time. They always have a subjective element and refer to the individual who holds them. This, surely, is the very essence of narrative, and it forms a significant portion of human conversation. Thus, the evolution of episodic memories may have allowed these hunter-gatherers (both past and present) to talk in the way that they do. Indeed, in that earlier paper Corballis himself suggested that, “a good deal of human conversation consists of mutual time travel down memory lane. Shared memories are the glue for the enlarged and complex social nets that characterise our species and go well beyond mere kinship” (Suddendorf & Corballis 1997, p. 139). But it may do more; I believe that recounting events in this way would have been a good vehicle for sharing knowledge of hunting, toolmaking, and any other area of subsistence.

The feeling I have about Corballis's present argument about modern human behaviour (I am not addressing the other dimensions of his article) is that learning to speak with the mouth instead of with both the mouth and the hands seems to be a rather pragmatic change; and yet, the changes that modern humans bring seem much more profound than that. Indeed, to many scholars, the diversity and speed of the changes has suggested that some kind of fundamental cognitive transformation occurred that led to the radically new types of behaviour on display. The development of episodic memory is just such a transformation, and scholars of human cognitive evolution stand to benefit from including it in their discourse. If Corballis sees fit to incorporate this kind of notion into his own narrative, then I believe that what will emerge is an even more comprehensive account of language origins than he already has.

Laterality probabilities fluctuate during ontogenetic development

Arve Vorland Pedersen^a and Beatrix Vereijken^b

^aDepartment of Physiotherapy, Faculty of Health Education, Sør-Trøndelag University College, Ranheimsvn. 10, N-7004 Trondheim, Norway; ^bHuman Movement Science Section, Faculty of Social Sciences and Technology Management, Norwegian University of Science and Technology, N-7491 Trondheim, Norway. Arve.Pedersen@ahs.hist.no
Beatrix.Vereijken@svt.ntnu.no
<http://www.svt.ntnu.no/idr/Beatrix.Vereijken/>

Abstract: We argue that lateralities are not merely a result of phylogenetic processes but reflect probability functions that are influenced by task characteristics and extended practice. We support our argument by empirical findings on lateral biases in early infancy in general, and footedness in particular, and on hand preferences in nonhuman primates.

Corballis discusses handedness and lateralities in general as phylogenetically developed when he states that there is a “general agreement that handedness is a function of the brain rather than of the hands themselves, and that it is related to other cerebral asymmetries of function” (sect. 1). We will argue that handedness is very much a function of the hands. Furthermore, he talks about handedness “whether defined in terms of preference or skill” (sect. 1). Others make clear distinctions between hand *preference* and hand *performance* or *skill*, and we will argue that this distinction is crucial. Even if initial hand preference might be phylogenetically determined, performance and eventual preference are determined in large part by ontogenetic development.

In this commentary, we discuss how lateralities develop ontogenetically, using the development of early handedness and footedness as illustration. We will further argue that lateral preferences are probability functions – not necessarily fifty-fifty – and that probabilities fluctuate during ontogenetic development. In the case of hand performance, we will argue that an initial lateral bias leads to excessive and prolonged use of the preferred hand over the nonpreferred hand. This causes increasing lateral differences between the two hands.

Lateral biases in early infancy. Early lateral biases have been found in various activities such as spontaneous head-turning (e.g., Rönnqvist et al. 1998), spontaneous hand closure (e.g., Cobb et al. 1966), and grasp reflex strength (e.g., Tan & Tan 1999). Furthermore, Corbetta and Thelen (1999) showed that biases in infants' arm movements are not stable characteristics but fluctuate during early development before they stabilize into clear lateral differences. Typically, hand skill develops towards greater asymmetry (Singh et al. 2001). However, most studies of hand skill tested performance on unimanual tasks that have a clear division of labor between the hands. This division often implies manipulation from one of the hands and a stabilizing function from the other. Such tasks would favor specialization of each hand, with prolonged practice leading to increased differences between the hands. This, again, would strengthen hand preference.

Changing lateral biases in foot performance. As with hand skill, foot skill is typically measured using unilateral tasks. In such tasks, one foot often stabilizes the body while the other acts on or manipulates an object (see Peters 1988). In such unilateral tasks, lateral differences in performance between the two feet typically increase with increasing age, although this pattern is less clear than for handedness. For bilateral tasks, such as, for example, walking, a more symmetrical use of the two legs would be favorable, which should lead to decreased lateralities over practice. This is exactly what we found in a recent study on the development of postural control in early walking.

At the onset of independent walking, infants walked in an asymmetrical pattern, indicating an early lateral bias (Pedersen et al. 2002). This bias was stronger when they carried extra loads. As they became more skilled walkers, lateral differences in this symmetrical task decreased. However, when we increased task demands by loading the infants, the lateral differences reappeared,

in that placement of one foot was systematically changed to create a larger base of support. Hence, whereas foot skill in unilateral tasks developed towards asymmetry, the opposite occurred in the symmetrical task of walking.

Hand preferences in primates. Corballis argues that the “strong predominance of right-handedness appears to be a uniquely human characteristic” (target article, Abstract). We argue that this may stem from the high incidence of manipulative actions in humans. As indicated above, manipulating objects favors specialization of the hands, thereby strengthening initial biases. Support for this position can be found in animal studies. Although a general bias towards one hand is not reported on a species level, non-human primates have been reported to show right-handedness under certain conditions. For example, gorillas, chimpanzees, and orangutans show a population-level right-hand preference in reaching from a bipedal posture but not so from a quadrupedal posture (Hopkins 1993; Olson et al. 1990). Only a bipedal posture frees both hands, allowing them to assume differential functions and thereby strengthen a lateral bias. Furthermore, Hopkins (1996) reports a weak right-handedness in chimpanzees, but only for some activities – for example bimanual feeding – and only in captivity. The latter may indeed have been “inadvertently shaped by the routine acts of the humans” (McGrew & Marchant 2001, p. 355).

Ontogenetic development of literalities. Empirical evidence indicates that lateral biases are present very early in development but fluctuate as a function of task characteristics and practice. From a dynamical systems perspective, development in general and movement behavior in particular are not deterministic but probabilistic (Thelen et al. 2001). Behavioral patterns are not prescribed but self-organize under the confluence of constraints resulting from the organism, the task, and the environment (Newell 1986). Within this framework, the expression of any lateral performance difference would be a function of initial asymmetries, subsequent environmental pressures towards further asymmetry or increased symmetry, and practice. The general dominance of the left hemisphere in vocalizations, handedness, footedness, and head-turning suggests that an initial asymmetry is indeed phylogenetically determined, in line with Corballis’s argument. An eventual lateral preference, however, is as much a result of ontogenetic development as it is of evolution.

In conclusion, we agree that initial lateral biases might exist. These initial biases lead to small performance differences that increase the probability of choosing one side over the other. With further practice and under the influence of task constraints, the strength of the lateral bias may change, creating either increased symmetric performance or stable lateral preferences.

ACKNOWLEDGMENT

This work was supported by a research grant from the Norwegian Research Council (No. 129273/330) awarded to the second author.

A zetetic’s perspective on gesture, speech, and the evolution of right-handedness

Amir Raz^a and Opher Donchin^b

^aDepartment of Psychiatry, Weill Medical College of Cornell University, New York Presbyterian Hospital – Westchester Division, White Plains, NY 10605;

^bDepartment of Biomedical Engineering, Johns Hopkins University, School of Medicine, Baltimore, MD 21205. amr2006@med.cornell.edu opher@bme.jhu.edu

Abstract: Charmed by Corballis’s presentation, we challenge the use of mirror neurons as a supporting platform for the gestural theory of language, the link between vocalization and cerebral specialization, and the relationship between gesture and language as two separate albeit coupled systems of communication. We revive an alternative explanation of lateralization of language and handedness.

The French philosopher Condillac proposed the gestural theory of language evolution in 1746; the anthropologist Hewes revived it in the 1970s (cf. de Condillac 1746/1947; Hewes 1973a; 1973b). Although this controversial theory has since had a number of advocates (Armstrong et al. 1995), Corballis has fleshed it out substantially, linking together ideas from a wide variety of fields including, most notably, the neurosciences (Corballis 1998a; 1998b). One of the major alternatives to a gestural theory of language – in which language can evolve gradually out of gesture – is a “Big-Bang” hypothesis, in which a number of the genetic specializations for humanlike language would evolve rapidly together (e.g., Crow 1998). Corballis’s eloquent discussion of how different stages in human evolution may have contributed to the transition from gesture to spoken language is certainly more appealing than a “step-function” spurt of evolution. However, as we argue below, its evidentiary bases are still meager.

The gestural theory has received more attention since Gallese and colleagues (Gallese et al. 1996) reported mirror neurons in monkey area F5. In addition to the target article, there have been a number of other related accounts that put mirror neurons at the heart of their gestural theory (e.g., Arbib 2002; Arbib & Rizzolatti 1997; Place 2000), and the author would have done well to clarify the differences between his approach and these accounts. One of the difficulties with basing a theory of language development around mirror neurons is that these neurons are not specialized for communicative gestures. Indeed, the opposite may be the case, as the reported data show neurons that respond during retrieval of food and other purposeful actions. Hence, mirror neurons are more typically considered in the context of “theory of mind” and not communication (cf. Williams et al. 2001). Recent data showing that mirror neurons respond to auditory as well as visual cues (Kohler et al. 2002) further undermine their characterization as protointerpreters of gestural communication. However, this may be only a minor issue that can be resolved by showing that mirror neurons (or, for that matter, Broca’s area) are equally or more strongly activated during gestural communication than during other actions. In any case, we believe this issue merits more attention.

To the best of our understanding, the major difference between this exposition of the gestural theory and other accounts is that here the left-hemispheric dominance for vocalization explains both right-handedness and left-hemispheric dominance for language. However, as the author himself notes, the evidentiary link between handedness and hemispheric dominance for language is still tenuous. Interpretation of the evidence that Corballis has considered is consistent with a genetic theory of handedness (Annett 1987b; McManus 1985b), in which right-handedness is coded genetically by an allele. However, Coren (1996) proposes an alternative to such theories. According to Coren, most scholars misconstrued the data demonstrating inheritance of handedness because left-handedness also correlates with early trauma (e.g., during birth). In the target article, Corballis does not adequately address Coren’s thesis, and even in his monograph (Corballis 2002), this account receives only minor attention.

About 13% of the current population is left-handed, and consistent data speak to the relationship between left-handedness and certain sensory disorders (e.g., Bonvillian et al. 1982; Lessell 1986), sleep disturbances (Coren & Searleman 1987), and other developmental disabilities (Temple 1990). Corballis (e.g., 2002) has admirably incorporated certain pathologies into his theory, touching on blindness, deafness, hemispatial neglect, and schizophrenia. However, we feel that the treatment of left-handedness, with its implications for his theory, has yet to be fully developed.

Using vocalization to explain handedness and language dominance has other weaknesses. This account rests largely on the lateralization of vocalization in birds. One species of frog is similarly lateralized in control of vocalization, but in other species data are available only regarding the perception of species-specific vocalizations, not their production. As pointed out in the target article, vocalization is not the only behavior with population-level asym-