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GESTURE, LANGUAGE ORIGINS, AND RIGHT HANDEDNESS
Commentary on Place on Language-Gesture

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Abstract

The right:left ratio of handedness is 90:10 in humans and 50:50 in chimpanzees. Handedness is hereditary both in humans and chimpanzees: Why did this lead to the selection of right handedness in humans? Perhaps in a gestural stage of the evolution of language it was an advantage for signers to share the same signing hand for learning and understanding one other's gestures.

Keywords

evolution, equivalence, gesture, homesigning, iconic, language, miming, pointing, protolanguage, referring, sentence, symbolic, syntax, vocalisation

I. INTRODUCTION

1. Place (2000) argues that speech arose from an earlier, now extinct, stage of gestural language. Support for this may come from the evolution of handedness. Roughly 90% of people are right handed. The circumstances selecting right-handedness have been mysterious since it would require that an individual skill be influenced in its selection by how it was practised by others in the seemingly irrelevant exercise of their handedness. Unlike other hand skills, however, gesturing might have been affected by the handedness of others. Gestures are (a) performed with a dominant hand, and (b) are most efficiently learnt and perceived when everyone communicating with them makes them with the same dominant hand. Moreover, (c) in nonhuman primates there is already a small bias for making gestures with the right hand. Thus, we would expect that if language went through an early gestural stage, it would not only have selected for a common hand dominance, but a right one (since this side possessed an initial advantage over the left). Below I expand upon this theory and argue that it can be refuted or confirmed by readily performed experiments.

II. THE RIGHT HANDED MAJORITY.

2. Why 90% of us use the right hand is a major unexplained fact in neuroscience and human evolution. Other animals including our nearest relative, the chimpanzee, show hand lateralisation that occurs in a 50:50 ratio (Marchant & McGrew, 1996). As handedness is inherited in nonhuman primates such as the chimpanzee (Hopkins, Bales & Bennett, 1994), this was most probably due to an ancient selection of a common right handedness.

3. For right handedness to evolve, there must be some advantage in every individual using the same hand. But such advantages are mostly weak because the advantages that individuals gain from hand skills are usually independent of which hand other individuals use. One possibility is artifacts: many tools are asymmetric (e.g., scissors and tin-openers). If they were manufactured for only one handedness, this would slightly disadvantage those with the other handedness. This is not an option for explaining the evolution of right handedness, however, because it is neither an important selective advantage (left handers can still use right handed scissors), nor one that would have shaped the adaptation of early hominids (artifacts were both simple and individually made by their own users).

4. Hand gestures provide a novel and unique circumstance for advantaging all individuals to share the same dominant hand. Hand signs can be made with the left or right hand. Gestures, however are more easily learnt and comprehended when those making and those perceiving them do so uniformly with one hand. Hand communication is an unusual skill in that the success of one individual depends upon how others do it. Thus, if language started off with gestures, we would expect natural selection to result in a uniform use of only one of the two hands.

III SIGN LANGUAGE.

5. For tasks requiring fine motor control, one hand is preferentially used, our dominant one. The making of sign-gestures by sign language speakers in conversation requires fine control for legibility to others and for temporal flow. Reflecting this, all modern deaf sign language speakers make their signs with one dominant hand (their other hand plays a complementary but severely restricted role, Brentari, 1998, p. 248). Fine motor control is lateralised in chimpanzees (Marchant & McGrew, 1996). It is reasonable, therefore, to assume that early hominids had dominant hands, and that they used them for making gesture signs. In chimpanzees, handedness is hereditary (Hopkins, Bales & Bennett, 1994), as it is in modern humans: it is therefore reasonable to suppose it was also hereditary in early hominids. This means that uniform handedness could have easily been selected if this advantaged the motor processes underlying the learning and comprehension of gestures. Mirror neurons (Rizzolatti, & Arbib, 1998) are likely to have been critical to the processing of early gestural language (para. 6); and mirror neurons could have important laterality sensitivity (para. 7).

IV. MIRROR NEURONS.

6. Mirror neurons are critical to any theory of gestural communication. They can explain: (a) how signs could be made that were readily understood, and (b) why spoken language arose from these abilities after early gestural language became extinct. First, mirror neurons are motor neurons that get activated when an animal performs an action, and when that animal sees that same action performed by another. Thus, they provide a means by which gesture-signs can be made and identified. Second, mirror neurons in nonhuman primates are found in the area of the premotor cortex homologous to Broca's area, which underlies human language: not surprisingly, mirror neurons have been linked to the origins of language (Rizzolatti, & Arbib, 1998; Skoyles, 1998). For gestural origins theory, mirror neurons provide a logical means by which hand movements could take on the new role of gestures; they could process not only their production but also their perception. Mirror neurons could hence be responsible for Broca's area turning into a specialised language area.

7. Mirror neurons in one hemisphere control the actions of one side of the body, thus the link between mirroring an action and performing it might have a laterality bias toward the handedness of that imitated action. Mirror neurons in the left hemisphere could respond best to hand movements by the right hand, and vice versa. There are two reasons this might be the case. First, we know that where the motor cortex is involved in perception, motor neurons can show such a lateralisation. In the perception of left and right hand shapes, right hand judgements activate part of the motor cortex in the left hemisphere, and left ones, the right one (Parsons et al, 1995). When we identify the leftness or rightness of a hand shape, it appears that this is done through the brain's mirroring that shape upon the neurological representation of our own body; as a result, the left hemisphere gets activated when identifying right hand shapes, and vice versa. Mirror neurons might likewise mirror body sidedness. Second, motor imagery is lateralised at the behavioural level. Martin and Jones (1999) have found that right handers preferentially imagine right sided head orientations (and vice versa).

8. If mirror neurons show handedness sensitivity then their involvement in the perception and production of gestures would have advantaged early hominids to select uniform handedness. Right handers would be better at learning and comprehending gestures made by other right handers than those made by left handers. This is not to suggest that communication would have been impossible if early hominids were 50:50 left and right hand dominant, only that it would be more efficient if everyone gestured with the same handedness. Selection for gestural communication would favour more efficient forms of signing (single handedness) rather than less (mixed handedness). A small right-hand bias for making gestures has been reported in bonobos (Hopkins & de Waal, 1995). Thus any pressure for efficiency in learning and using sign-gestures would have led to the selection of uniform right handedness.

V. MODERN RIGHT HANDEDNESS.

9. According to the gestural theory of language, vocal language later evolved and supplanted gestural language. Speech, unlike gestural language, is not advantaged by people sharing the same hand. Thus, when spoken language arose, the selection pressure for continuing right handedness would have ceased. This would have allowed for the rise of a left handed minority. One advantage favouring their selection would be that right handers who have practised in combat only against other right handers would be at a disadvantage with the occasional left hander. Thus, left handedness only arose after the development of vocal language.

VI. PREDICTIONS.

10. Neurologically, there should be a link between the production and the perception of contralateral hand movements by mirror neurons. Behaviourally, left handers should learn complex hand movements better from other left handers than from right handers (and vice versa). The selection of handedness occurred before the development of full syntax and vocabulary, hence its demonstration in children would be more important than in adults (they are more comparable to early hominids in their lack of fully developed syntax and vocabulary). For a related reason, similar lateralisation advantages should exist in gesture speaking chimpanzees such as Washoe.

11. Another novel and unexpected prediction concerns left handers. First, two facts about American sign language (ASL): a few ASL speakers use the left hand as their dominant speaking hand. Second, all the hand movements made by the dominant hand can on occasions also be made by the nondominant hand (for example, when reciting poetry, Brentari, p 249). Since language drove handedness (rather than the other way around), left hand dominance in signing should be linked not to manual lateralisation in the brain but to language. This can be tested, as roughly one in ten left handers lateralise language control not to their right hemisphere, but their left (Pujol, Deus, Losilla & Capdevila, 1999): Such left handers with left hemisphere language should speak ASL with their right hands.

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