

Gesture as precursor to language: Evidence from bimodal bilingualism

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Two hypotheses frequently cited within the frameworks of language origin are (i) vocal origins and (ii) gestural origins (van Schaik, 2016). The vocal hypothesis argues that language arose among hominins as a result of vocal learning after hominins acquired the ability to learn vocalizations socially due to changes that occurred in ape vocalizations. The gestural hypothesis states the features of language evolved among apes in gestural communication and were later transferred to the vocal domain. Supporters of the gestural hypothesis point to the universal occurrence of co-speech gestures among humans (e.g., Corballis, 2013) and shared properties of human language and gestural communication in nonhuman primates (Meguerditchian, Cochet & Vauclair, 2011) as evidence. They further mention the advantages of speech over gesture for the universal presence of language in the auditory-oral modality, e.g., the ability to communicate in the dark or while making tools (Corballis, 2002). If we assume that language had gestural origins and that gesture and speech have co-existed for an extended period, it sounds plausible to predict that the human brain has then evolved to be capable of simultaneously not only producing speech and sign but also of doing so in two different (i.e., mismatching) orders. Investigating this claim requires that the language user have the extraordinary physical ability to produce a proposition via two output channels simultaneously in two typologically different languages. Such an ability is only available to bimodal bilinguals, i.e., individuals competent in a spoken language and a signed language and can thus use speech and sign to express the same sentence (Donati, 2021). In this study, we examined whether the human brain can express the same sentence simultaneously not only in two different modalities but also two different word orders. The two languages are Khuzestani Arabic (KhA) and Sadat Tawaher Sign Language (STSL). STSL is a young sign language that emerged naturally approximately sixty years ago in a family in a small village named *Sadat Tawaher* in southwestern Iran after a man lost his hearing and has since been in use. STSL arose in complete isolation from any other sign language(s) and with none of its

signers having had any prior knowledge of or exposure to any sign language. Since STSL signers speak when they sign, we examined whether they would produce their output following the same order or different word orders. The participants were 9 native signers (5 males and 4 females; aged 19-54) who are all hearing and who had learned KhA as their mother tongue. However, they used STSL to communicate with the deaf person who himself did not sign but could speak normally to communicate with others as he lost his hearing long after he had learned his mother tongue, KhA, in his early twenties. This created a unique situation which, to the best of our knowledge, is unattested in the literature. In terms of proficiency, the participants were fully balanced and fluent in both KhA and STSL. Furthermore, comparing KhA and STSL is justified as the two languages are typologically different in that while KhA is head-initial (as reflected in its SVO order, preverbal position of negators, and *wh*-movement), STSL is head-final (as seen in its sentence-final placement of completive aspect markers, negators, and *wh*-signs). The data consisted of sentence productions and storytelling, totaling 1988 sentences (524 declaratives, 283 *wh*-questions, and 1181 negative sentences). The results showed that, overall, 442 (22%) of the speech/sign strings had a matching order (i.e., congruent lexicalizations) while 1546 strings (78%) had mismatching orders (i.e., incongruent lexicalizations). Furthermore, the signers adhered to the same grammar in 332 declaratives (63%) and 110 *wh*-questions (39%), but used a different word order for all the negative sentences (i.e., 100% mismatch). Our findings clearly indicate that the bimodal bilingual mind not only actively hosts two languages in two different modalities but is also capable of producing them simultaneously in two different orders, via the vocal tract and the hands (and face). The data also indicated cross-modal influence from speech to sign and sign to speech as evidenced in utterances with *wh*-doubling and of bimodal bilinguals' preference for code-blending (i.e., using both speech and sign) over code-switching which is consistent with previous research (e.g., English-ASL, Emmorey, et al., 2003). The results have implications for the architecture of the bilingual mind and what it can achieve. Bimodal bilinguals seem to avoid costly inhibitory control and additional processing costs by taking advantage of the suspension of articulatory constraints. These results might also provide support for gesture as the first phylogenetic precursor of human language and seem to be in line with the findings of some recent studies that have documented the existence of a bimodal intentional communicative system in captive chimpanzees (Hopkins, Taglialatela, & Leavens, 2007). This bimodal intentional system was preceded by communicative gestures in the common ancestor of humans and chimpanzees (Meguerditchian, et al., 2011). In conclusion, the findings provide support for the historical connections between gesture and speech and for a single integrated communication system that oversees both vocal and gestural communication. Whether these findings imply that speech has supplanted gesture over time remains open-ended (see McNeill, 2012).

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