

## IDEAS & SPECULATIONS

### Insights & Perspectives

# Life of p: A consonant older than speech

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#### Abstract

Which sounds composed the first spoken languages? Archetypal sounds are not phylogenetically or archeologically recoverable, but comparative linguistics and primatology provide an alternative approach. Labial articulations are the most common speech sound, being virtually universal across the world's languages. Of all labials, the plosive 'p' sound, as in 'Pablo Picasso', transcribed /p/, is the most predominant voiceless sound globally and one of the first sounds to emerge in human infant canonical babbling. Global omnipresence and ontogenetic precocity imply that /p/-like sounds could predate the first major linguistic diversification event(s) in humans. Indeed, great ape vocal data support this view, namely, the only cultural sound shared across all great ape genera is articulatorily homologous to a rolling or trilled /p/, the 'raspberry'. /p/-like labial sounds represent an 'articulatory attractor' among living hominids and are likely among the oldest phonological features to have ever emerged in linguistic systems.

#### KEYWORDS

bilabials, great apes, language evolution, primate linguistics, speech evolution, speech origins, speech sounds

## INTRODUCTION: /P/ FOR 'PERVASIVE'

Around the world, labials are the most ubiquitous component of the world's spoken languages (hereafter *languages*). Among these, the speech sound /p/ occurs in ~93% of languages<sup>[1]</sup> (see Supporting Information [SI]), making it the most dominant voiceless sound within the most dominant sound class in speech. The few languages that currently do not use /p/ contrastively – that is, to generate word meaning – typically have its voiced counterpart /b/ and owe its loss to relatively recent divergence from a mother language that did have /p/.<sup>[2]</sup> In the 2092 languages in the Phoible database,<sup>[1]</sup> which includes roughly 30% of the world's known languages, only 14 languages lack /p/ and /b/. These languages are spoken in Africa and North and South America; however, they all exhibit some other form of labial features in their phonological inventories. Africa, for example, is notable for lacking /p/,<sup>[3–5]</sup> but it is also a linguistic area that displays frequent borrowing of /p/,<sup>[6]</sup> such that when it is lost due to sound change, it is easily reintroduced via lex-

cal borrowing. Moreover, the four languages in Africa that lack both /p/ and /b/ all contain the bilabial nasal /m/ and two of those additionally contain the bilabial fricative /β/. In the Americas, all languages lacking /p/ and /b/ contain labials /m/, /β/, or /w/ (a voiced labial approximant) to various degrees. Lastly, we find that no ancient or reconstructed languages are likely to have lacked labial plosives<sup>[7,8]</sup> (see SI), suggesting that some languages' lack of pure labials is due to recent sound changes.

Global and historical prevalence suggest, therefore, that key inherent characteristics of /p/ and labial sounds may have long assisted in their use and adoption. Ease of articulation and acquisition likely represent such characteristics. The rapid rise-and-release of air pressure at the lips – which identifies /p/ and /b/ as bilabial 'plosives' – is relatively simple motorically, but creates a clear acoustic contrast with many other speech sounds. The fact that word meanings are created by sound contrasts helps explain why /p/ has been efficiently deployed across cultures over the course of history. At the same time, in terms

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of fidelity of perception and processing, compared to sounds produced inside the vocal tract without lip rounding, lip protrusion (and showing teeth) is visually striking,<sup>[9]</sup> working simultaneously as an attention getter and an overt demonstration of how to produce the sound. Such features help explain why languages missing a /p/ or its equivalents are so exceptionally rare.

## /P/ FOR 'PREMATURE'

The view that articulatory ease works in concert with perceptual conspicuousness and functional effectiveness is supported by developmental precocity during speech ontogeny in human infants.<sup>[10]</sup> /p/ and other (plosive) bilabials like /m/ are among the earliest sounds to emerge during language acquisition, comprising both canonical babbling and the first syllables produced by budding language users.<sup>[10]</sup> From the perspective of articulation, this makes sense. Infants have more adult-like control of their jaw and lips than their tongue (one of the most flexible and anatomically complex muscles in the body).<sup>[11]</sup> Thus, the production of labial sounds precedes articulatorily more difficult and biomechanically more precise speech sounds, which appear after formative years of increasing speech motor control and practice.<sup>[12]</sup>

## /P/ FOR 'PRIMATES'

Evolutionarily, the prevalence of /p/ and affinitive sounds suggests that they date back to the first 'mother tongue' in the human lineage, that is, the last common ancestral sound stock of all the world's major language families. Phylogenetic reconstructions of ancient and extinct languages cannot trace sound beyond ~10 kya<sup>[13]</sup> to confidently determine the presence of specific sounds deep into evolutionary time. Sound also instantly biodegrades, leaving no trace in the fossil record. Nevertheless, comparative ape linguistics can help resolve the possibility that bilabials such as /p/ are among the oldest sounds of language.

The raspberry is the only currently known vocal tradition present in all great apes – *Pongo* (orangutans), *Gorilla* (gorillas), *Pan* (chimpanzees and bonobos) and *Homo* (humans). The call is universal across all nonhuman genera, but only found in some populations of each genus, where it has emerged and socially diffused to become a local-specific tradition.<sup>[14]</sup> Critically, raspberries are rolling voiceless bilabial plosives. They are articulatorily homologous to human prototypical consonants in general<sup>[15]</sup> and homologous to a trilled /p/ sound in particular – a splutter resulting from the release of air through slightly tense and protruded lips.

Where they are present, raspberries are produced by wild orangutans during nest-building,<sup>[16]</sup> in wild gorillas they appear to be associated with feeding and in wild chimpanzees are produced during social grooming.<sup>[17]</sup> In captivity, where they occur, raspberries are used by the three genera as attention-getters towards human caregivers and are used in at least one chimpanzee group as a pant-hoot concatenated unit.<sup>[18]</sup> Such disparate contexts and apparent

independent origins corroborate the view that effective production and perception of /p/-like sounds expands well beyond humans within the hominid family. Bilabials seem to be biologically 'dormant' in all living hominids but materialise as part of a population's repertoire of social traditions.

Additional evidence for the importance of bilabial sounds among living (nonhuman) hominids comes from orangutans, the great ape with the richest consonant-like repertoires described to date.<sup>[19]</sup> Across various calls and contexts, the most frequently produced and universal consonant-like call is the kiss-squeak.<sup>[20]</sup> The production of a kiss-squeak is equivalent to that of a kiss sound by humans. The sound is, thus, also a voiceless bilabial sound similar to a /p/ but instead of resulting from the *ex*-plosive release of air through pressed lips, it results from the *im*-plosive pull of air through protruded lips.

## /P/ FOR 'PRIMAL'

Great ape raspberry articulation, use and cultural nature align with the near universality and early ontogeny of /p/ and plosive bilabials across the world's languages, confirming these sound's putative ancient evolutionary age within the human clade.<sup>[21]</sup> Great ape raspberries show that bilabial plosives are not exclusive to language and that they are biologically easy to produce and culturally easy to adopt.

This ape-human articulatory link also helps to address an established enigma with regard to the geographic and phylogenetic distribution of /p/-like sounds and other bilabials across the world's languages; while pervasive, these sounds show historical signs of only very rarely being lost and thus rarely needed to be created anew, raising questions about why and how they have 'survive[d] processes of sound change and lexical replacement over long periods of time.'<sup>[21]</sup> The view that /p/-like sounds and bilabials are supported by hominid vocal tract anatomy and physiology help explain why they appear largely immune to cultural differentiation or drift.

If /p/ and bilabials more generally are indeed a sound relic from the forerunner system of speech, and one of the first phonological features of the first language(s), then one of the predictions would be that /p/ and bilabials should be used in association with some of the most fundamental aspects of life across communities. As it turns out, this is indeed the case; compared to other basic sounds, the world's languages show a non-random allocation of /p/ and bilabials as the onset sound of words that signify the major staple food within the society where each language is spoken.<sup>[22]</sup> The evolutionary age of /p/ means that the sound has been available for longer periods of time than most other speech sounds. This has resulted in a convergence in sound use and meaning across (ancestral) communities motivated in similar ways to communicate about some of life's essentials, such as the foods that meet individuals' most nutritional and caloric needs.

Together, bilabial plosive sounds like /p/ were a very likely presence in the consonantal inventories of ancient hominid vocal systems, and for this reason, they are also present in the vast majority of languages that subsequently evolved and diversified across human cultures. It is

plausible that /p/-like sounds preceded language itself and that they partook in the most significant stages and structures in the vocal-to-verbal transition along the human lineage. The identification of a living consonant relic in great apes invites a new, broader and serious approach to 'primate linguistics' for an improved understanding of the evolutionary timeline of speech.

## CONCLUSION: /P/ FOR 'PAST PRESUMPTIONS' AND 'PROSPECTIVE PROGRESS'

Primate linguistics carries major implications for how researchers and scholars think about the evolution of human communication and language, and can produce fresh insights and approaches to this tantalising process. A seemingly continuous stream of schools has thus far worked on the premise that human communication and language are *not* evolutionarily related to that of great apes and other nonhuman primates. The origin of human communication and language must have therefore, it is argued, depended on dramatic, qualitative and exclusive changes that took place sometime, somewhere or somehow recently in our evolutionary lineage. Some schools of thought forward that changes had to have occurred in human neuronal substrates underlying vocal control (e.g., Kuypers–Jürgens hypothesis of speech evolution<sup>[23–25]</sup>)<sup>14</sup>, others in the modularity and channel of human primary signals (e.g., gestural and multimodal hypothesis of language evolution<sup>[26–30]</sup>), in human neuro-computational capacities,<sup>[31]</sup> or in how humans think about and understand other's communication signals and motivations.<sup>[32,33]</sup> It may seem as though 'anything goes'; however, the most parsimonious view is that spoken language is a derived feature exapted on the vocal communication, cognition and cultures of pre-human and ape-like ancestors, for which there is cumulating evidence (e.g.,<sup>[14,34–40]</sup>). This is not to negate the importance of these hypotheses' chosen features for human communication and language, but instead to stress how these features are recurrently assumed to be unreservedly distinct from vocal production and perception in great apes before adequate and socio-ecologically valid assessments have been made. As consequence, the need for saltational evolutionary scenarios for the origins of human communication and language have more often been a logical outcome of researchers' priors than a logical conclusion taken from modern observations and experiments with great ape vocal behaviour in field and in naturalistic settings.

Primate linguistics represents *the* first principles approach to the evolution of human speech and language. The observation that modern languages produce meaning using sounds that are amongst the first to emerge in human infants and that can be retraced to a last common ape ancestor's repertoire of vocal traditions confirms that human communication and language have been prompted on hominid vocal and cultural biology. New strides connecting linguistic and ape 'typologies' are expected to help resolve many of the supposed 'missing links' for the emergence of language and help gradually reconstruct language evolution's gradual timeline.

For example, important constructive strides are taking place in the study of quasi-vowels in great apes,<sup>[41,42]</sup> which will predictably allow

for a better estimation of the vowels that composed human ancestors' 'mother-tongue'. Complementarily, because each and every language is *universally* composed by vowels *and* consonants, it is critical to continue cataloguing the consonant-like repertoire of great apes<sup>[15,43]</sup> and to identify the conditions that propelled their evolutionary diversification in the human lineage.<sup>[19]</sup> Ultimately, we will place ourselves in the best position to understand how and why consonants and vowels became inseparable and thriving 'vocal symbiotes.'<sup>[44,45]</sup>

## AUTHOR CONTRIBUTIONS

Adriano R. Lameira and Steven Moran conceived and wrote the paper.

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## CONFLICT OF INTEREST

The authors declare no competing interests.

## DATA AVAILABILITY STATEMENT

Data and code are available in the Supplementary Information (SI).

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## SUPPORTING INFORMATION

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