

TIMELINE FOR SCIENTIFIC RESEARCH ON THE EVOLUTION OF LANGUAGE AND SPEECH

Most work has been concentrated in three main areas:

- scenarios or 'storylines' depicting the initial emergence of language among our ancestors
- evidence of how language processes are organized in the human brain
- estimates of the potential of the great apes to learn elements of language, and of the linguistic abilities of our fossil ancestors

ANCIENT HISTORY

MAIN POINT	DETAILS
<p>An Egyptian papyrus (the Edwin Smith Surgical Papyrus, dated to c.1700 BC but perhaps copied from a 3000 BC original) records diagnostic details of 48 medical cases, including one of a person who suffered localised brain damage and lost the capacity to speak. This is often cited as the first recorded diagnosis of aphasia (loss of speech capacity due to brain damage)</p>	<p>"Case 22. Instructions concerning a crushing blow to the temple.</p> <p>Examination: If you examine a man having a crushing blow to his temple, you should place your thumb on his chin (and) your finger further back on his jaw, so that the blood will flow front his two nostrils (and) from the interior of his ear having that crushing blow. Cleanse (it) for him with a swab of linen until you see its fragments (of bone) in the interior of his ear. If you call to him (and) he is speechless (and) cannot speak...</p> <p>Diagnosis: You should say concerning him: "One having a crushing blow to his temple; he discharges blood from his two nostrils and from his ear; he is speechless; (and) he suffers with stiffness in his neck. An ailment not to be treated."</p>
<p>The Greek historian Herodotus (5th Century BC) records a story of one of the Egyptian pharaohs, who conducted an experiment to see which culture and language was the oldest by ordering two children to be raised in linguistic isolation. He wanted to see what words the children would spontaneously produce.</p>	<p>"Now the Egyptians, before the reign of their king Psammetichus, believed themselves to be the most ancient of mankind. Since Psammetichus, however, made an attempt to discover who were actually the primitive race, they have been of opinion that while they surpass all other nations, the Phrygians surpass them in antiquity. This king, finding it impossible to make out by dint of inquiry what men were the most ancient, contrived the following method of discovery:- He took two children of the common sort, and gave them over to a herdsman to bring up at his folds, strictly charging him to let no one utter a word in their presence, but to keep them in a sequestered cottage, and from time to time introduce goats to their apartment, see that they got their fill of milk, and in all other respects look after them. His object herein was to know, after the indistinct babblings of infancy were over, what word they would first articulate. It happened as he had anticipated. The herdsman obeyed his orders for two years, and at the end of that time, on his one day opening the door of their room and going in, the children both ran up to him with outstretched arms, and distinctly said "Becos". When this first happened the herdsman took no notice; but afterwards when he observed, on coming often to see after them, that the word was constantly in their mouths, he informed his lord, and by his command brought the children into his presence. Psammetichus then himself heard them say the word, upon which he proceeded to make inquiry what people there was who called anything "becos", and hereupon he learnt that "becos" was the Phrygian name for bread. In consideration of this circumstance the Egyptians yielded their claims, and admitted the greater antiquity of the Phrygians.</p> <p>That these were the real facts I learnt at Memphis from the priests of Vulcan. The Greeks, among other foolish tales, relate that Psammetichus had the children brought up by women whose tongues he had previously cut out; but the priests said their bringing up was such as I have stated above."</p>

THE SEVENTEENTH AND EIGHTEENTH CENTURIES

MAIN POINT	DETAILS
<p>Early European encounters with great apes stimulate speculation about their intelligence and linguistic potential.</p>	<p>Speculation about the language potential of apes began with the first specimens brought to Europe during the 17th century. Samuel Pepys records in his diary for Saturday 24 August 1661:</p> <p>“At the office all the morning and did business; by and by we are called to Sir W. Batten’s to see the strange creature that Captain Holmes hath brought with him from Guiny; it is a baboon, but so much like a man in most things, that though they say there is a species of them, yet I cannot believe but that it is a monster got of a man and she- baboon. I do believe that it already understands much English, and I am of the mind it might be taught to speak or make signs.”</p> <p>We would now speculate that the animal referred to as a ‘great baboon’ was in fact a gorilla or chimpanzee.</p>
<p>The German rationalist philosopher Johann Gottfried von Herder, in his 1772 essay ‘On the Origin of Language’, argues that humans can adapt to such a wide range of environments because they are able to think reflectively about the world they see (and not respond instinctively). He argues that reflection requires the ability to categorise phenomena and give them names. Language is then simply the external expression of the use of reason.</p>	<p>“Man, placed in the state of reflection which is peculiar to him, with this reflection for the first time given full freedom of action, did invent language.... Man manifests reflection when the force of his soul acts in such freedom that, in the vast ocean of sensations which permeates it through all the channels of the senses, it can ... single out one wave, arrest it, concentrate its attention on it, and be conscious of being attentive. He manifests reflection when, confronted with the vast hovering dream of images which pass by his senses, he can collect himself into a moment of wakefulness and dwell at will on one image... and can select in it distinguishing marks for himself so that he will know that this object is this and not another. He thus manifests reflection if he is able not only to recognize all characteristics vividly or clearly but if he can also recognize and acknowledge to himself one or several of them as distinguishing characteristics. The first act of this acknowledgment results in a clear concept; it is the first judgment of the soul--and through what did this acknowledgment occur? Through a distinguishing mark which he had to single out and which ... struck him clearly...</p> <p>Let that lamb there, as an image, pass by under his eyes; it is to him, as it is to no other animal. Not as it would appear to the hungry, scenting wolf! ... Not as it appears to the rutting ram which feels it only as the object of its pleasure... Not as it appears to any other animal to which the sheep is indifferent and which therefore lets it ... pass by because its instinct makes it turn toward something else--Not so with man! As soon as he feels the need to come to know the sheep, no instinct gets in his way; no one sense of his pulls him too close to it or too far away from it.... White, soft, woolly--his soul in reflective exercise seeks a distinguishing mark--the sheep bleats! His soul has found the distinguishing mark.... This bleating, which makes upon man’s soul the strongest impression, which broke away from all the other qualities of vision and of touch, which sprang out and penetrated most deeply, the soul retains it.!”</p>
<p>The French romantic philosopher Jean-Jacques Rousseau, in his 1781 essay ‘On the Origin of Language’, argues that the first words were used to express our emotions</p>	<p>“...it follows that the origin of language has nothing to do with our basic needs; it would be absurd for a cause which drives people apart to be also the one which unites them. Where then could language have come from? From moral needs, from emotion. The emotions bring together people driven apart by the need to seek out a means of subsistence. It is neither hunger nor thirst, but love, hate, pity, and anger which seized the first voices. Fruit does not hide itself from our hands, we can feed ourselves without speaking; we hunt the prey we want to eat in silence: but to move a young heart or to push back an unjust aggressor, it is natural to use tones, cries, and complaints. This is how the oldest words were invented, and this then is why the first languages were musical and emotive before they became simple and rational.”</p>

THE NINETEENTH CENTURY

MAIN POINT	DETAILS
<p>In the second half of the nineteenth century, doctors begin to get a better understanding of which parts of the human brain are involved in speech and language processing. Their research is based on studying brain-damaged patients whose brain damage has caused them to lose normal language abilities.</p>	<p>Pierre Paul Broca (French doctor, lived 1824-1880) showed in 1861 by post-mortem examination, that patients in his surgical ward with loss of speech ability had damage to the left frontal region of the brain. This brain region became known as 'Broca's Area'.</p> <p>Karl Wernicke (German doctor, lived 1848-1905) showed in 1874 that patients with damage to a more posterior region of the left side of the brain suffered loss of the ability to understand others' speech. This brain region became known as 'Wernicke's Area'.</p>
<p>Charles Darwin writes, in 1871, of the possible route by which language might have evolved gradually from the simpler forms of communication seen in other living species of animal.</p>	<p>" language ... certainly is not a true instinct, as every language has to be learnt. It differs, however, widely from all ordinary arts, for man has an instinctive tendency to speak, as we see in the babble of our young children ... Moreover, no philologist now supposes that any language has been deliberately invented; each has been slowly and unconsciously developed by many steps. The sounds uttered by birds offer in several respects the nearest analogy to language, for all the members of the same species utter the same instinctive cries expressive of their emotions; and all the kinds that have the power of singing exert this power instinctively; but the actual song, and even the call-notes, are learnt from their parents or foster-parents. These sounds, as Daines Barrington has proved, "are no more innate than language is in man." The first attempts to sing "may be compared to the imperfect endeavour in a child to babble." The young males continue practising, or, as the bird-catchers say, recording, for ten or eleven months. Their first essays show hardly a rudiment of the future song; but as they grow older we can perceive what they are aiming at; and at last they are said "to sing their song round." Nestlings which have learnt the song of a distinct species, as with the canary-birds educated in the Tyrol, teach and transmit their new song to their offspring. The slight natural differences of song in the same species inhabiting different districts may be appositely compared, as Barrington remarks, "to provincial dialects;" and the songs of allied, though distinct species may be compared with the languages of distinct races of man. I have given the foregoing details to shew that an instinctive tendency to acquire an art is not a peculiarity confined to man.</p> <p>With respect to the origin of articulate language, after having read on the one side the highly interesting works of Mr. Hensleigh Wedgwood, the Rev. F. Farrar, and Prof. Schleicher, and the celebrated lectures of Prof. Max Müller on the other side, I cannot doubt that language owes its origin to the imitation and modification, aided by signs and gestures, of various natural sounds, the voices of other animals, and man's own instinctive cries. When we treat of sexual selection we shall see that primeval man, or rather some early progenitor of man, probably used his voice largely, as does one of the gibbon-apes at the present day, in producing true musical cadences, that is in singing; we may conclude from a widely-spread analogy that this power would have been especially exerted during the courtship of the sexes, serving to express various emotions, as love, jealousy, triumph, and serving as a challenge to their rivals. The imitation by articulate sounds of musical cries might have given rise to words expressive of various complex emotions ... As monkeys certainly understand much that is said to them by man, and as in a state of nature they utter signal-cries of danger to their fellows, it does not appear altogether incredible, that some unusually wise ape-like animal should have thought of imitating the growl of a beast of prey, so as to indicate to his fellow monkeys the nature of the expected danger. And this would have been a first step in the formation of a language.</p>

THE NINETEENTH CENTURY (CONTINUED)

MAIN POINT	DETAILS
<p>(CONTINUED) Charles Darwin writes, in 1871, of the possible route by which language might have evolved gradually from the simpler forms of communication seen in other living species of animal.</p>	<p>As the voice was used more and more, the vocal organs would have been strengthened and perfected through the principle of the inherited effects of use; and this would have reacted on the power of speech. But the relation between the continued use of language and the development of the brain has no doubt been far more important. The mental powers in some early progenitor of man must have been more highly developed than in any existing ape, before even the most imperfect form of speech could have come into use; but we may confidently believe that the continued use and advancement of this power would have reacted on the mind by enabling and encouraging it to carry on long trains of thought. A long and complex train of thought can no more be carried on without the aid of words, whether spoken or silent, than a long calculation without the use of figures or algebra. ... The intimate connection between the brain, as it is now developed in us, and the faculty of speech, is well shewn by those curious cases of brain-disease, in which speech is specially affected, as when the power to remember substantives is lost, whilst other words can be correctly used.</p> <p>Why the organs now used for speech should have been originally perfected for this purpose, rather than any other organs, it is not difficult to see. Ants have considerable powers of intercommunication by means of their antennæ, as shewn by Huber, who devotes a whole chapter to their language. We might have used our fingers as efficient instruments, for a person with practice can report to a deaf man every word of a speech rapidly delivered at a public meeting; but the loss of our hands, whilst thus employed, would have been a serious inconvenience. As all the higher mammals possess vocal organs constructed on the same general plan with ours, and which are used as a means of communication, it was obviously probable, if the power of communication had to be improved, that these same organs would have been still further developed; and this has been effected by the aid of adjoining and well-adapted parts, namely the tongue and lips. The fact of the higher apes not using their vocal organs for speech, no doubt depends on their intelligence not having been sufficiently advanced. The possession by them of organs, which with long-continued practice might have been used for speech, although not thus used, is paralleled by the case of many birds which possess organs fitted for singing, though they never sing. Thus, the nightingale and crow have vocal organs similarly constructed, these being used by the former for diversified song, and by the latter merely for croaking."</p> <p>From Charles Darwin, <i>On the Descent of Man and Selection in Relation to Sex</i> (London: Murray, 1871)</p>
<p>The German linguist F. Max Muller (lived 1823-1900) derides Darwin's and other theories which suggest that language could have been derived by gradual evolution from the kinds of vocal signals seen in other animals today.</p>	<p>F. Max Muller followed the rationalist view of an essential difference between humans and animals, and declared language to be "the Rubicon that no brute will dare to cross." He proposes in his book on the <i>Science of Language</i> (1861) that languages can be traced back to their roots by looking at similarities among distantly-related languages, similarities that must be due to common ancestral forms. He sees this 'roots' approach as incompatible with theories of the origins of the first words, such as those that invoked onomatopoeia (and suggested that the first words sounded like the things they were describing), or those that looked to interjections (and suggested that the first words were derived from expressions of emotions). Darwin responded (letter to Muller, 1873) that one "fully convinced, as I am, that man is descended from some lower animal, is almost forced to believe a priori that articulate language has developed from inarticulate cries." Muller later comes to see that his 'roots' approach deals with the historical origins of modern languages, and that the onomatopoeia and interjection theories deal with word formation in an earlier period of time; but his initial satirical comments about these latter theories (the 'bow-wow' and the 'pooh-pooh' theories, as he jokingly called them) have a lasting negative impact.</p>

THE NINETEENTH CENTURY (CONTINUED)

MAIN POINT	DETAILS
<p>La Société de Linguistique de Paris (the newly-set up French learned society for the scientific study of languages), founded in 1866, bans discussion of the origin of language on the grounds that this is pure speculation</p>	<p>Article 2 of the Statutes of the Linguistics Society of Paris (founded in 1866): “The Society accepts no communications concerning either the origin of language, or the creation of a universal language.” The London-based Philological Society followed suit in 1872. One reason for these bans was to give room for the emerging science of linguistics to develop, based on the analysis of fully-formed languages. However, the ban and the attitudes which underlay it had a lasting impact on studies of the origin of language during the next 100 years, as linguists focused almost exclusively on how language works in its fully-evolved modern forms (and avoided consideration of how it may have evolved).</p>
<p>In 1891 the Dutch anatomist Eugene Dubois finds the first fossils of a human ancestor species in Indonesia, and calls them <i>Pithecanthropus erectus</i> – ‘the ape-man who walked upright’. He cannot tell whether or not this species used language.</p>	<p>When Darwin published <i>The Origin of Species</i> in 1859, no fossils of human ancestor species had yet been found. A German biologist, Ernst Haeckel, believed that such fossils would be found and urged his students to go and hunt for them. Haeckel believed that language was the defining characteristic of modern humans so he coined a name for the then-undiscovered ‘missing link’ species - <i>Pithecanthropus alalus</i> – which meant ‘the ape-man who could not speak’. However when Dubois, who had been inspired by Haeckel, did later find fossilised bones of a human ancestor species, Dubois realised that they could not be used to confirm the presence or absence of language ability but that they could be used to infer an upright posture – so the new species was called <i>Pithecanthropus erectus</i></p>

THE TWENTIETH CENTURY ONWARDS

MAIN POINT	DETAILS
<p>A partial skeleton of a Neanderthal is recovered at La Chapelle-aux-Saints, France, in 1908. A debate ensues – still not resolved – about the linguistic ability of this very close relative of our own species, now of course extinct.</p>	<p>Marcel Boule, the French anatomist who initially examines this fossil, writes that “It is probable, therefore, that Neanderthal Man must have possessed only a rudimentary psychic nature, superior certainly to that of the anthropoid apes, but markedly inferior to that of any modern race whatsoever. He had doubtless only the most rudimentary language...” Subsequent analysis undermines Boule’s conclusions, but they establish a popular negative stereotype of the Neanderthals – a stereotype which has proved hard to shift.</p>
<p>Noam Chomsky, an American linguist (born 1928), argues that humans are born with an innate, or hardwired, knowledge of a universal grammar. He observes that all languages share certain rules and that children learn languages with astonishing speed.</p>	<p>In the late 1950s Chomsky challenges the then-dominant school of American psychology, ‘behaviourism’, which argued that even the most complex-seeming behaviour – language – could be explained as a product of conditioned associative learning. Chomsky argues that this cannot explain the speed and seeming effortless with which children acquire language. Humans must be born with an innate mechanism for language acquisition. Chomsky’s theory does not explain the evolutionary origins of this innate ability, nor the way in which it is implemented in the human brain. Perhaps, in his view, it arose as a chance mutation in an individual, who then passed on the advantageous genes to his or her offspring. Researchers today continue to ask: Is language a uniquely human skill? And is language capacity a self-contained part of the brain or part of a more complex, integrated system of cognitive skills?</p>

THE TWENTIETH CENTURY ONWARDS (CONTINUED)

MAIN POINT	DETAILS
<p>Studies of vervet monkeys in Africa, in which their alarm calls are recorded and played back to them from concealed loudspeakers, show that they are sensitive to acoustic cues signalling different kinds of predator (eagle, leopard, snake).</p>	<p>The results are published in 1980, and seem to demonstrate that nonhuman primates can communicate using signals that refer the hearer's attention to objects in the environment: this shows that not all monkey calls are simply expressions of emotional reactions.</p>
<p>There are several attempts to train captive great apes to communicate with humans using language, from the 1920s onwards. It emerges that chimpanzees cannot learn to use a spoken vocabulary, and results of sign language experiments are mixed. Later work with a keyboard apparatus shows however that humans and chimpanzees can communicate using words and using some basic grammatical rules for combining them.</p>	<p>Ape language experiments offer a window into the minds of our closest living relatives. Initial attempts to teach chimpanzees to learn and to use spoken words are unsuccessful. Vicki, a chimp reared in a human family home and trained to vocalize words for ten years in the 1940s, was able only to produce four rasping utterances ('mama', 'papa', 'up', 'cup'). It was soon realised that chimpanzees cannot use the vocal channel to communicate in this way, either because their vocal tracts are not shaped to enable such production, or because their own characteristic vocalizations are emitted in states of high excitement – and they lack the brain circuitry required to override these emotion-related triggers. Subsequent work involved training chimps to communicate using conventionalized hand gestures (sign language). Scientists' attention was also shifting from the size of the vocabulary a chimp could learn, to looking for evidence of any basic grammatical ability (could they combine words in meaning ways?). One of the chimps involved was even called 'Nim Chimpsky', referring to the role it was thought the experiments might have in challenging Chomsky's views. Initially the results were encouraging, but in the 1970s it became apparent that no sentences were being produced. In a widely quoted paper in the journal Science, "Can an Ape Create a Sentence?" Nim Chimpsky's trainer, Dr. Herbert Terrace, a Columbia University psychologist, reluctantly concluded that the answer was no. In the 1980s Sue Savage-Rumbaugh, a primatologist at Georgia State University, decided to try a different approach. To eliminate the ambiguity of hand signs (previous workers had read too much into the free-form hand movements of their chimp trainees), she used a keyboard with dozens of buttons marked with geometric symbols. She worked with a bonobo (another species of chimpanzee) called Kanzi. Tests show that Kanzi understands not only words but basic grammar up to about the level of a two-year-old human child - the strongest evidence so far that species other than humans can acquire human language skills.</p>

THE TWENTIETH CENTURY ONWARDS (CONTINUED)

MAIN POINT	DETAILS
<p>Genetic studies of a family whose members display selective deficits in speech articulation leads to the identification (controversially) of a 'speech and language' gene. Further studies suggest that this gene evolved into the form found in modern humans some time in the last million years, and a copy of the same form of the gene is recovered from the bones of a Neanderthal.</p>	<p>The main findings and claims for their significance were published in the journal Nature in 2002. Defects in the human form of this gene (known as FOXP2) are associated with developmental verbal dyspraxia – a difficulty in producing the coordinated movements required for fluent speech. They are also associated with a wider set of symptoms, not all language-related, which has led some scientists to be suspicious of claims that the evolution of this form of the gene is a sufficient marker of brain reorganization for human speech and language.</p>
<p>Bones from the root of the tongues of two extinct hominin species are excavated and show a change from a chimp-like to a human-like form, implying the evolution of greater control of the articulatory apparatus.</p>	<p>The older of the two hyoid bones comes from Ethiopia and belongs to a species (<i>Australopithecus afarensis</i>) known to have walked on two legs, and to have had a brain of similar size and a body of similar mass as a modern chimpanzee. This species lived between about 3.5 and 2.9 million years ago in East Africa, and is an ancestor of modern humans. The more recent hyoid belongs to a Neanderthal, and was found in an archaeological site in Israel. Neanderthals lived in Europe and the Near East during the ice ages and went extinct about 30,000 years ago. They evolved as a sister branch with modern humans, with a last common ancestor in Africa about half a million years ago. The fact that the Neanderthals had hyoid bones like ours implies that they may also have had a similar capacity to produce articulate speech. The finds were reported by scientists in 1989 (Neanderthal hyoid) and 2006 (<i>A. afarensis</i> hyoid).</p>
<p>It is suggested that human language evolved to enable us to manage large networks of social relationships.</p>	<p>Robin Dunbar, a British scientist, argues in a series of influential publications in the late 1980s and early 1990s that humans evolved their large brains and their language ability in order to cope with the demands of living in increasingly large social groups. Other primates maintain their personal alliances by grooming (where one animal picks bugs from the fur of its ally), but this is very time-consuming; language enables us to build and maintain relationships simultaneously with more than one conversational partner. Dunbar argues that his theory is supported by the correlation between brain size and group size found when comparing living primate species, and also by the large amounts of time which people spend today 'gossiping' – building trust by sharing information about the past behaviour and future intentions of absent third parties.</p>

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