

9/10/26

I'm attaching the syllabus for UN3450 for Fall 2026. Please review the topics before we meet on September 8th. At the end of the first seminar, I will ask students for their preferences for giving a seminar and confirm their choices later that day. Changing your mind later would complicate finding other students to cover that topic. I'm also attaching a preface for a book I'm writing on the evolution of language. This is not required reading. I want to highlight some of the topics we will be discussing during the seminar. I'd be happy to answer any questions you have before we meet next Thursday.

UN3450 Syllabus FALL 2026

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Seminar meets on Thursday afternoons (2:10-4:00) in 828 Uris Hall. Office hours: Thursday, 10-11 AM, and other times to be announced.

This seminar will systematically review the implications of Darwin's theory of evolution for contemporary studies of animal and human cognition, with particular emphasis on the evolution of language.

Format of the course: Each student will lead a seminar on a topic of their choice, selected from the following list.

1. September 10 INTRODUCTION
2. September 17 READING PERIOD (Prep. for October 8 seminar)
3. September 24 READING PERIOD (Prep. for October 15 seminar)
4. October 1 READING PERIOD (Prep. for October 22 seminar)
5. October 8 THEORY OF EVOLUTION
6. October 15 CONDITIONED BEHAVIOR

7. October	22	ANIMAL & PRIMATE COGNITION
8. October	29	ANIMAL COMMUNICATION & APE LANGUAGE
9. November	5	WALLACE'S PROBLEM & INFANT CONDITIONING
10. November	12	HUMAN COGNITION & ARTIFICIAL INTELLIGENCE
11. November	19	HUMAN ANCESTORS & ORIGIN OF COOPERATION
November 26-27 Thanksgiving Day Break		
12. December	3	INTERSUBJECTIVITY & JOINT ATTENTION
13. December	17	PROTOLANGUAGE & POINTING

All assigned readings, in PDF format, will be posted one week before each seminar. All students (except the presenter) are asked to submit one or two questions about the assigned readings by **email by 6 pm** on the **Wednesday** before each seminar. Those questions will help the presenter focus on his/her topic.

Grades, on a 100-point scale, will be calculated as follows:

Seminar presentation:	40 points
Seminar participation:	10 points
Written questions on readings:	10 points
Take-home exam:	40 points

Grades for seminar participation will be calculated as follows: 10 points for submitting questions about assigned readings each week, and 10 points for participating in discussions of seminar topics.

To ensure that students have adequate time to prepare their seminars, I will meet with students who have chosen one of the earlier topics as needed during the first few weeks of the semester. The purpose of those meetings is to provide a basis for preparing the seminar. I will, of course, also meet with all students prior to their seminars. I envision at least 2 meetings with each student. Please schedule an appointment to meet with me at least three weeks before your topic's scheduled date.

There will be eleven seminars. I intend to cover all the topics, but in some cases, two students may be assigned to lead a seminar on a particular date. How this works will be determined by individual preferences discussed during the first seminar meeting on September 10th and by the number of students who actually enroll in the course.

Background reading. I will assign readings for each student to ensure that he/she can lead a discussion on that topic. Readings could include those listed on the following pages and others you would like to add.

Selection of assigned readings for the seminar. These readings (all in PDF format) will be circulated at least one week before each seminar.

Preparation of an outline for the talk. After discussing those aspects of a particular topic to be highlighted in the seminar, each student will be asked to prepare a 1-2-page outline for their seminar.

Annotated bibliography. Each student should select 2-3 readings that were especially helpful for his/her talk and summarize in a short paragraph what was special about that reading. The annotated bibliography should **NOT** be in the format of a book report. Instead, it should provide commentary about the innovation, incisiveness, brilliance, etc., of a particular reading. These bibliographies will be helpful for each student while they work on a take-home exam.

Seminar outline: The leader(s) of each topic will distribute his/her outline before their seminar.

Circulation of Annotated Bibliographies and PowerPoint Presentations: Be sure to circulate an annotated bibliography for your talk on the day on which you present it. These are usually helpful for students preparing their take-home exams. For the same reason, it would be helpful to circulate your PowerPoint presentation if you used one.

Mid-semester evaluation: Before each seminar, students will be required to submit 1-2 questions about the assigned readings. These questions will be graded on a pass/fail basis and will contribute to the student's score on "seminar participation". Midway through the semester, students' questions will be used to assess their progress in the seminar.

Take-home exam: About 3 weeks before the end of the seminar, I will distribute an essay exam covering the topics discussed in this seminar.

The exam will be due one week after final exams begin.
Previous take home:

Write a critical essay on the evolution of intelligence and language that addresses the following issues.

- How do animal species differ qualitatively with respect to their intelligence?
- What evidence is there that animals think without language?
- Are computers conscious and/or intelligent?
- What are the roles of dyadic and triadic interactions on the development of language?
- How did language evolve from animal communication? Your answer should comment on the significance of Wallace's problem.

Your paper should be ~10-20 double-spaced pages. When I grade it, I will be concerned with:

1. The clarity of your arguments about the positions you take on each issue focuses on the degree to which you agree with my position (or with anyone else's).
2. Your ability to include information from your own reading and from seminar discussions

Each question should be answered separately (1-2 double-spaced pages). Please be sure to attach both a bibliography and an annotated bibliography. Your bibliography should document each point you make, where relevant. Your **annotated bibliography** should contain ~5 references that you thought were particularly helpful.

Please review the topics to be covered before we meet on September 10 to ensure they are as you expected.

Introduction: Discussion of rationale for each week's topic.

Evolution: One of biology's great mysteries is how language developed from animal communication. All animals communicate, but only humans use language. Given the limited overlap between the involuntary expressions of a narrow range of animal emotions and the voluntary exchange of unlimited amounts of information between humans, some scientists refer to the evolution of language as the "hardest problem of science"¹.

Darwin: The theory of evolution, natural selection, mutations, genetic drift and other bases for changes of species. Peculiar to the study of language is the dyad of the

speaker and the listener. Another question is, what has to be explained; just the origin of words and grammar, or related factors such as cooperation?

Ayala, F. (2008). Science, evolution and creationism. *Proceedings of the National Academy of Sciences USA*, 105, 3-4.

Dawkins, R. (1976). The Selfish Gene. New York, NY, Oxford University Press.

Wallace's problem: Wallace, the co-founder of the theory of evolution, disagreed with Darwin after originally agreeing that biological typically result from natural selection. Wallace asked why language evolved given that it "was more than nature needs", specifically, how did language insure survival?

Bickerton, D. (2014). *More Than Nature Needs: Language, Mind, and Evolution*. Cambridge, MA: Harvard University Press (Chapter 1).

Levinson, S. (2014). Language and Wallace's problem. *Science*, 344(6191), 1458-1459.

Ape language experiments: Why non-spoken languages were used to train chimpanzees to communicate. Why attempts to teach them a gestural language (American Sign Language) and artificial visual languages failed. The importance of considering imperatives (as opposed to declaratives) and rotely-learned sequences as purported instances of language.

Gardner, B. T., & Gardner, R. A. (1969). Teaching sign language to a chimpanzee. *Science*, 162, 664-672.

Premack, D. (1971). Language in chimpanzees. *Science*, 172, 808-822.

Terrace, H. (2019). *Why chimpanzees can't learn language and only humans can*. New York: Columbia University Press. (Chapter 2).

Pre-human ancestors – Chimpanzees → Homo erectus: Chimpanzees are our closest living ancestors. At the start of the ape language experiments, little was known about other ancestors. During the last 40 years, many additional ancestors were discovered. Some are more plausible candidates for originating

language than chimpanzees because of the shift from a quadrupedal to a bipedal gait, an increase in brain size, changes in dietary requirements and the beginning of stone tool technology.

Terrace, H. (2019). *Why chimpanzees can't learn language and only humans can*. New York: Columbia University Press. (Chapter 3).

Wood, B. (2005). *Human evolution. A very short introduction*. New York: Oxford University Press.

Pre-human ancestors (continued) – Homo habilis → Homo sapiens: To continue this discussion, we will read selected excerpts from the following texts:

Dawkins, R. (2004). *The ancestor's tale*. New York: Houghton Mifflin.

Klein, R. (1989). *The human career: Human biological and cultural origins*. Chicago: University of Chicago Press.

Lewin, R. (2005). *Human evolution: an illustrated introduction*. Malden, MA: Blackwell.

Human Memory & AI:

Atkinson, R. C. and R. M. Shiffrin (1971). "The control of short-term memory." Scientific American **225**(2): 82–90.

Searle, J. (1990). "In the Brain's Mind a Computer Program?" Scientific American **262**: 26–31.

Infancy

04-Piaget.doc

Cooperative breeding: Most scholars of language evolution recognize that the first use of language, in particular words, presupposed an unusual ability to cooperate. Psychologists and biologists have written extensively about the origin of cooperation, particularly above the level observed in apes. In this seminar, I will focus mainly on Hrdy's view that cooperative breeding was needed to achieve that level of cooperation. With cooperative breeding, a natural mother allows kin, and other peers, to look after a

newborn infant, -a practice that is diametrically opposed to that observed in apes, where a mother wouldn't allow anyone to attend to an infant until she is six months old. Infants reared by collective rearing attempt to solicit more care from various mothers (alloparents), as compared to that obtained from a natural mother. Hrdy argues that collective breeding in human ancestors in particular, in *Homo erectus*, was crucial in their learning to share food (a necessary condition for the caloric requirements of their large brains) and, ultimately, and in naming food sources that had to be cooperatively scavenged.

Burkart, J. M., Hrdy, S. B., Van Schaik, C. P. (2009). Cooperative Breeding and Human Cognitive Evolution. *Evolutionary Anthropology*, 18, 175-186.

Hrdy, S. (2009, October 10). How humans became such other-regarding apes. Retrieved from <http://onthehuman.org/2009/08/how-humans-became-such-other-regarding-apes>.

Hrdy, S. B. (1999). *Mother nature: A history of mothers, infants, and natural selection*. New York: Pantheon Books.

Hrdy, S. B. (2005). Cooperative Breeders with an Ace in the Hole. In E. Volland, Chasiotis, A., Schiefenhovel, W. (Ed.), *Grandmotherhood: The Evolutionary Significance of the Second Half of Female Life* (pp. 295-311): Rutgers University Press.

Intersubjectivity: Because of a reduction in the size of the pelvis, the volume of the brains of human infants at birth is reduced relative to that of other ancestors. Because of their limited mobility, human infants must be cradled until they are 6 months old. That arrangement allows infants and mothers to gaze into each other's eyes more so than in other primates. That is the basis of an intense exchange of affect between an infant and her mother, starting at birth. As recent research by developmental psychologists shows, this *dyadic* relation, called intersubjectivity, gives rise to many rhythmic exchanges of sound and bodily movement between mother and infant. Evidence of intersubjectivity can be observed shortly after birth.

Terrace, H. (2019). *Why Chimpanzees Can't Learn Language And Only Humans Can*. New York: Columbia University Press. (Chapter 4, first part)

Joint attention: Once an infant begins to crawl, she comes into contact with many objects in her environment and often picks them up or points to them to draw a parent's attention.

The *triadic* relation among an infant, a parent, and an object gives rise to a cognitive interaction between the infant and her parent, which adds to previously established nonverbal interactions during intersubjectivity. Once an infant and a parent can share attention to an object, it is relatively easy to attach a name to that object. In hindsight, the reason why chimpanzees could not learn to name objects is their lack of a history of intersubjectivity and joint attention.

Bruner, J. S. (1983). *Child's Talk: learning to use language*. New York, NY: W.W. Norton.

Terrace, H. (2019). *Why Chimpanzees Can't Learn Language And Only Humans Can*. New York: Columbia University Press (Chapter 4, second part).

Phylogenetic and Ontogenetic Origins of Words: Bickerton was one of the few linguists to specifically address the origin of words and the first to consider Wallace's problem in explaining the evolution of language. His was the most reasonable explanation of the origin of words (protolanguage) and, hence, the first step in explaining the evolution of language by natural selection. Bickerton's hypothesis about the use of words and scavenging by *Homo erectus* is the only answer to Wallace's problem that depends on natural selection. Other explanations, such as pair bonding, hunting, and making tools, fail that test.

Bickerton, D. (2014). *More Than Nature Needs: Language, Mind, and Evolution*. Cambridge, MA: Harvard University Press (Chapters 3 & 4).

Bickerton, D., Szathmary, E. (2011). Confrontational scavenging as a possible source for language

There is general agreement that words evolved before grammar both phylogenetically and ontogenetically. There is also general agreement that initial word learning requires a foundation of intersubjectivity and joint attention. As discussed by Bruner, Bloom, McNamara, and Tomasello, initial word learning follows from shared intentionality.

Bloom, P. (2000). *How Children Learn the Meanings of Words*. Cambridge: The MIT Press

Bruner, J. S. (1983). *Child's Talk: learning to use language*. New York, NY: W.W. Norton.

Macnamara, J. (1972). Cognitive basis of language learning in infants. *Psychological Review*, 79(1), 1-13.

Tomasello, M. (1999). *The Cultural Origins of Human Cognition*. London: Harvard University Press

What is a Word?

Burling, R. (2011). Words came first: adaptations for word-learning. In K. R. Gibson & M. Tallerman (Eds.), *The Oxford Handbook of Language Evolution*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199541119.013.0044>

Bergelson, E., & Aslin, R. (2017, 11/20). Nature and origins of the lexicon in 6-mo-olds. *Proceedings of the National Academy of Sciences*, 114, 201712966. <https://doi.org/10.1073/pnas.1712966114>

Bergelson, E., & Swingle, D. (2012, 02/28). At 6–9 months, human infants know the meanings of many common nouns. *Proceedings of the National Academy of Sciences of the United States of America*, 109, 3253-3258. <https://doi.org/10.1073/pnas.1113380109>

Clark, E. V. (1973). WHAT'S IN A WORD? ON THE CHILD'S ACQUISITION OF SEMANTICS IN HIS FIRST In T. E. Moore (Ed.), *Cognitive Development and Acquisition of Language* (pp. 65-110). Academic Press. <https://doi.org/https://doi.org/10.1016/B978-0-12-505850-6.50009-8>

Gervain, J., & Mehler, J. (2010, 02/01). Speech Perception and Language Acquisition in the First Year of Life. *Annual Review of Psychology*, 61, 191-218. <https://doi.org/10.1146/annurev.psych.093008.100408>

Greenfield, P. M., Lyn, H., & Savage-Rumbaugh, E. S. (2008). Protolanguage in ontogeny and phylogeny: Combining deixis and representation. *Interaction Studies*, 9(1), 34-50. <https://doi.org/https://doi.org/10.1075/is.9.1.04gre>

Levinson, S. C., & Holler, J. (2014). The origin of human multi-modal communication. *Phil. Trans. R. Soc. Lond. B*, 369(1651). <https://doi.org/10.1098/rstb.2013.0302>

Premack, D. (1990). Words: what are they, and do animals have them? *Cognition*, 37, 197-212.

Students with Disabilities: Students with special needs who may require classroom/assignment accommodations should make an appointment with me before or during the first week of class. You should also contact the Office of Disability Services (ODS) in Lerner Hall before the start of the course to register for these accommodations. The procedures for registering with ODS can be found here: <https://health.columbia.edu/services/register-disability-services>

Academic integrity: As members of this academic community, we are responsible for maintaining the highest level of personal and academic integrity: “[E]ach one of us bears the responsibility to participate in scholarly discourse and research in a manner characterized by intellectual honesty and scholarly integrity.... The exchange of ideas relies upon a mutual trust that sources, opinions, facts, and insights will be properly noted and carefully credited. In practical terms, this means that, as students, you must be responsible for the full citations of others’ ideas in all of your research papers and projects... [and] you must always submit your own work and not that of another student, scholar, or internet agent” (from the Columbia University Faculty Statement on Academic Integrity).

During your work for this course, please keep in mind the following Faculty Rules regarding academic integrity.

The intellectual venture in which we are all engaged requires of faculty and students alike the highest level of personal and academic integrity. As members of an academic community, each one of us bears the responsibility to participate in scholarly discourse and research in a manner characterized by intellectual honesty and scholarly integrity.

Scholarship, by its very nature, is an iterative process, with ideas and insights building one upon the other. Collaborative scholarship requires the study of other scholars’ work,

the free discussion of such work, and the explicit acknowledgement of those ideas in any work that influence our own. This exchange of ideas relies upon a mutual trust that sources, opinions, facts, and insights will be properly noted and carefully credited.

In practical terms, this means that, as students, you must be responsible for the full citations of others' ideas in all of your research papers and projects; you must be scrupulously honest when taking your examinations; you must always submit your work and not that of another student, scholar, or internet agent.

Any breach of this intellectual responsibility is a breach of faith with the rest of our academic community. It undermines our shared intellectual culture, and it cannot be tolerated. Students who fail to meet these responsibilities should expect to be asked to leave Columbia.

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DRAFT

In the Beginning There Were No Words

Herbert Terrace

Columbia University

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In the Beginning There Was the Word?

Tales of animals talking to humans, and vice versa, are ancient. Aesop's fables are a well-known exampleⁱⁱ. People of all ages identify with the moral conflicts of animals and humans in stories such as *The Tortoise and the Hare*, *The Boy Who Cried Wolf*, *United We Stand; Divided We Fall*, and *Necessity Is the Mother of Invention*. We know that, of course, those tales are fiction.

During the latter part of the 20th century, various psychologistsⁱⁱⁱ, myself included, attempted to show that animals could actually learn a human language. These studies assumed that their subjects could imitate their teachers' use of language.

Why apes? Because they are the most intelligent and social of all extant animal species. But, because apes cannot voluntarily produce sounds, many of these projects were based on an ape's ability to use a gestural language, such as American Sign Language, a language used by thousands of deaf people (*add reference*).

I will discuss the details of these projects in Chapter 2. For the moment, I'd like to comment on their trainers. None were linguists or cognitive psychologists. Instead, they were behaviorists who believed that language was composed of conditioned responses.

In hindsight, that approach was painfully naïve, especially because they often failed to distinguish between animal communication and language. All animals, including humans, communicate. But only humans communicate with language, a form of communication that requires knowledge of words and grammar. That knowledge must be learned.

What is the difference between humans conversing with one another about danger and a monkey warning other monkeys about specific predators? Vervet monkeys generate alarm calls in many situations. For example, to warn other monkeys about danger from eagles, snakes, and leopards. But because a vervet's alarm calls are innate, vervet monkeys cannot be said to use language. By contrast, a human in a similar situation can choose between thousands of learned responses, for example, "this is a hostile situation," "au secours!", or "we should get help", etc.

The origin of words is a difficult and neglected topic. According to the Bible, "In the Beginning Was the Word"^{iv}. But what came before words? If you're a creationist, nothing. Language, specifically words, was God's gift to Adam^v. If you're not, the question becomes, whence language?

Darwin,^{vi} argued that language evolved from the emotional signals that animals use to communicate with one another^{vii}. That transition, however, is poorly understood. Specifically, how did the vast vocabulary that any human can learn evolve from a small set of innate emotional signals?

Many scholars have concluded that the evolution of language is “The Hardest Problem of Science”^{viii}. But as I will discuss below, the evolution of language can be simplified by recognizing that language is *not a distinct entity*. It has many component parts that are invisible to an untutored eye. For example, few parents are aware that their infants belong to the most cooperative species ever to exist. Or that intersubjectivity builds trust that is also uniquely human?

Words that an infant learns to identify objects pose similar problems. Instead of asking how language evolved, we should ask how words evolved. And, before that, how did *nonverbal abilities*, which are foundational for language, evolve? They include spontaneous acts of friendship (hyper-cooperation)^{ix}, deep affective exchanges with a caregiver that develop from birth (intersubjectivity)^x, and shared experiences (joint attention)^{xi}.

Some examples of these abilities are shown in Figures 1-3. They will be discussed in Chapters 3 & 4. Meanwhile, the reader should ask, could they be observed in animals? Clearly not.

Figure 1

Hypercooperation



Figure 2
Intersubjectivity



Figure 3
Joint attention



How did words evolve? Figure 4 shows how many psychologists regard the development of these abilities.

Figure 4

Animal Communication → Arbitrary Words

*Animal Communication → *Non-verbal Behavior* → Arbitrary Words.

**Non-verbal Behavior: Hypercooperation* → Intersubjectivity → Joint Attention

*Animal Communication → *Hypercooperation* → Intersubjectivity → Joint Attention to Objects

*Animal Communication → *Hypercooperation* → Intersubjectivity → Joint Attention to Objects

*Animal Communication → *Hypercooperation* → Intersubjectivity → Joint Attention → Using Arbitrary Words

Grammar has been the focus of most discussions of the origin of language. Without questioning its importance, I will focus here on the evolution of words. Why not grammar? An obvious reason is that there could be no grammar without words. Equally important is the profound difference between the limited number of innate emotional signals that comprise animal communication and the innumerable voluntary words that humans learn. For those reasons, I regard the transition from animal communication to words as important as the transition from words to grammar.

Grammar, the rules for ordering and inflecting words, is easy to define. There is no doubt that grammar is uniquely human. Opinion is divided, however, as to whether that's true of words.

Some psychologists erroneously regard animal signals as words. For example, the utterances that vervet monkeys make in response to specific predators^{xii}. The same is true of the utterances by apes in experiments on ape language^{xiii}. In Chapter 9, I will define words and show why they are uniquely human.

Most scholars have taken the origin of words for granted^{xiv}. Indeed, Noam Chomsky, the world's most well-known linguist, commented that,

"words...the minimal meaning-bearing elements of human languages...are radically different from anything known in animal communication systems. Their origin is entirely

obscure, posing a very serious problem for the evolution of human cognitive capacities, language in particular”^{xv}.

For more than 70 years, Chomsky and his students explored the nature of grammar at the expense of words. But neglecting the origin of words, in the quest to understand grammar, strikes me as putting the cart before the horse. It’s like trying to understand molecules without understanding the nature of elements or the atoms that comprise them.

From Animal Communication to Words. Animal communication is ancient. Its sole function is to promote an individual’s survival by *influencing another’s behavior*. That’s been true for the approximately 5 billion species that have evolved since life began, about 3.5 billion years ago^{xvi}.

The ability to use words emerged relatively recently. Many scholars argue that this occurred within the last two million years. Words allowed our ancestors to “escape from the prison of animal communication” by enabling them to *share* knowledge that was not related to survival^{xvii}.

Instead of expressing a small number of emotions to others^{xviii}, our ancestors *invented* words, a *new form of voluntary communication* that allowed them to share knowledge conversationally.

During the transition from words to grammar, the medium of communication remained the same. To master a grammar, our ancestors had to learn how to combine *existing* words in particular orders and how to inflect them.

By contrast, animal signals are *innate, involuntary, and unchangeable*. Birds sing to attract mates and to defend their territory. Dogs bark to express anger, while cats do the same by growling. Vervet monkeys produce distinct alarm calls to warn others about specific predators.

Words are *learned, arbitrary, conversational, and abundant*. Children can learn any of the approximately 7,000 languages spoken today with equal ease. Children can also translate words^{xix}. Different words can express the same meaning. It doesn’t matter whether one says *dog, chien, hund, perro, paolo, or sobaka*.

We learn new words at an astonishing rate. By their second birthday, children acquire words at the rate of one every two hours. By first grade, children typically know around 13,000 words^{xx}. Many readers know at least 50,000 words^{xxi}. As science, technology, and culture expand, so does our vocabulary.

Maynard Smith, a renowned biologist, regarded the emergence of language as one of the eight major evolutionary transitions^{xxii}. That’s high praise, considering that the other transitions included the origin of life and the development of multicellular organisms. I

agree that the evolution of language was an extraordinary event, primarily because it occurred relatively recently and within a single genus (*Homo*). I would, however, argue that the transition from animal communication to words was equally significant.

Pre-verbal Foundations of Language. A British psychoanalyst insightfully described the origins of words by emphasizing their social and *emotional* roots.

“Before language, there was something...more primitive...that propelled us *into* language...That something else was *social engagement with each other*. The links that can join one person's mind with the mind of someone else...were laid at the point when *ancestral primates* began to connect emotionally in the same way that human babies connect with their caregivers”^{xxiii}.

In recent years, developmental psychologists have focused on that connection in studies on *intersubjectivity* and *joint attention*. Both are crucial precursors of an infant's first words.

Intersubjectivity refers to exchanges of affect between an infant and her caregiver. We remember the joy of playing with infants, but not the specific structure and details of those games, such as peek-a-boo^{xxiv}. Without words, infants as young as five months play that game, showing pleasure and surprise each time a caregiver disappears and reappears.

At around six months, infants begin to crawl and walk. When they encounter a toy or an object, they often point to it and smile at their caregiver. The relation between an infant, her caregiver, and an object is referred to as joint attention (ref. Figure 3). I will summarize an infants knowledge of these nonverbal abilities in Chapters 7 and 8.

Pointing, which is an infant's way of saying *that*, allows an infant to share her experiences with her caregivers^{xxv}. Universally, this gesture occurs at around nine months. An infant utters her first word about two months later, after she points to an object. That is why a developmental psychologist described pointing as “the royal road to language”^{xxvi}.

For intersubjectivity to develop, the level of cooperation of our ancestors had to increase above that of apes, for whom competition is the norm. Sarah Hrdy, an eminent anthropologist, attributed that level of cooperation in recent ancestors to collective breeding, a practice in which infants are reared by both their mothers *and* other members of their group. Collective breeding resembles the current practice of rearing infants in extended families^{xxvii}.

In contrast to apes, whose infants are raised exclusively by their mothers, mothers who have evolved more recently allowed other group members to assist in rearing their infants. Those caretakers, who are known as *alloparents*, can be grandparents, parents, siblings, or even non-kin^{xxviii}.

A collectively bred infant must discern her mother's kin and other members of her group, mother's emotions, and learn how to relate to her^{xxix}. They face the same challenge with an alloparent. Infants who could relate to alloparents were more likely to survive than those who were less adept at forming such relationships. That selection pressure helped foster the high degree of cooperation crucial to the development of intersubjectivity.

However language began, we must keep in mind that it is a social endeavor. No man is an island. That truism is critical when considering how infants learn to speak. Language evolved in concert with non-verbal features of human behavior, all of which are social.

A thought experiment should reveal the significance of that truism. Imagine a robot trying to teach an infant to speak. The robot, which can expertly attend to the infant's basic needs, is also knowledgeable about infant language development. Most readers would expect the robot to fail. But why?

Robots are unable to comprehend or express emotions, a necessary condition for learning a language. I also suspect that a robot would be unable to engage in non-verbal cognitive relations, such as joint attention.

Can an Ape Learn Language? It was once hoped that the origin of words could be traced to apes, our closest living ancestor. As I will discuss in Chapter 3, various attempts to teach apes to communicate with gestures have failed, including my own^{xxx}. Apes can be trained to gesture, but only to obtain a reward, that is, to beg. By contrast, human infants learn to speak conversationally, that is, to share information that is *not necessary for their survival*.

***Homo erectus*.** If our only living ancestors couldn't learn language, to which ancestor should we turn? It would have to be an ancestor who evolved *after* the split between apes and hominids, about six million years ago. I will describe those ancestors in Chapter 4. For the moment, however, I would like to focus on *Homo erectus*, an ancestor who evolved approximately two million years ago. There's a strong consensus that *Homo erectus* invented language^{xxxi}.

The evidence is circumstantial. But just as scientists speculate about the origin of the universe, or of life, it is reasonable to speculate about the origin of language. As we gather more information about past events, we can refine our theories by evaluating them in the light of new evidence.

In recent years, paleoanthropologists have discovered fossils of more than two dozen hominin species that evolved *after* our human ancestors split from chimpanzees, approximately 6,000,000 years ago. Around that time, the environment in East Africa underwent a radical change. Wet jungles, in which our ancestors could swing from one tree to another, were replaced by drier, more open regions. That change made it more difficult to obtain food than in the jungle^{xxxii}.

Two significant anatomical changes occurred following the split between chimpanzees and hominins. About 4 million years ago (*reference*), the quadrupedal gait of our ancestors became bipedal. This allowed them to use their hands to carry food and other objects, and to make tools. About two million years later (*reference*), there was a dramatic increase in brain size, particularly in *Homo erectus*, whose brain size became three times as large as that of a chimpanzee's^{xxxiii}.

Homo erectus is the longest-lived of all human species^{xxxiv}. We don't know just when and why they became extinct, but they seemed to have survived for at least 2 million years ago. No other primate survived for that long. *Homo erectus* was also the first ancestor to leave Africa, traveling halfway around the world to the Middle East, southern Asia, China, and Java^{xxxv}.

Protolanguage. It has been argued that *Homo erectus* communicated through *protolanguage*, a language consisting of individual, unordered utterances^{xxxvi}. In protolanguage, two or more utterances that occurred together didn't imply a particular meaning. For example, the meanings of the utterances "*Bill hit*" and "*hit Bill*" are equivalent.

What was the form of protolanguage? It is unlikely that it was vocal because a chimpanzee's vocal utterances are involuntary and innate. Gestures are a more plausible medium.

Pointing may have played a significant role in the origin of words (cf. chapter 5)^{xxxvii}. Chimpanzees don't point in the wild, but they do so in captivity (*reference*). Under those circumstances, they point to objects to obtain a reward; that is, they point *imperatively*. They don't, however, point *declaratively* to draw attention to an object for its own sake.

In *all* human languages, infants point declaratively, typically before they produce their first words. As mentioned earlier, such pointing is often interpreted as an utterance meaning "that". Given a chimpanzee's ability to point imperatively, it's not too much of a stretch to argue that *Homo erectus* used the same gesture to point declaratively.

The pervasive role of gestures is still evident in an adult's use of language. Over 90% of speakers gesture when they talk^{xxxviii}. Those gestures appear every few seconds. People gesture even when listeners can't see their evidence, for example, during a phone conversation. Infants who are blind from birth also gesture^{xxxix}.

All languages, whether spoken or gestural, are learned in social settings where adults model words for infants. This is achieved first by imitating their utterances and then by engaging infants in conversations that use the target word. *Homo erectus* didn't have that luxury because it lacked linguistic culture.

To understand this difficulty, consider ancestors who had no words. Even when a “word” (vocal or gestural) was uttered, it is unlikely that its meaning was initially understood. Many attempts were needed for two or more *individuals* to agree on the meanings of such utterances.

Protolanguage is easy to describe, but difficult to produce. I’ve yet to encounter anyone who could communicate one word at a time. Try it, and you’ll probably feel tongue-tied. Years of expressing yourself grammatically are bound to get in the way. Just the same, one-word utterances were all that our ancestors could produce.

As the size of *Homo erectus*’ vocabulary grew, so did the demand on working memory. At some point, it became large enough to require grammatical rules for organizing its contents (*reference*). I suspect that it would have taken tens of thousands of years for that to happen within a particular group of *Homo erectus*. Similarly, it would have taken ages to develop a simple grammar, for example, one that would allow communication in the present tense.

The use of protolanguage has been likened to two other forms of communication: “pidgin” languages and the utterances of apes in experiments on “ape language”^{xl}. A moment’s thought will show why neither explanation is valid.

Pidgin language is used by people who already know how to use words. For example, if a person who only knew English tried to communicate with someone who only knew French, their conversation would likely consist of individual English and French words, as well as social cues, such as pointing. That cannot explain the origin of words in protolanguage because *Homo erectus* grew up in a culture that was non-verbal

A comparison of protolanguage utterances with those of apes trained to use sign language fails because apes could only learn to use signs imperatively (cf. Chapter 2). Language, as we know it, would never have evolved if our ancestors’ utterances were limited to imperatives.

How were words invented? I suggest the following scenario. When a *Homo erectus* pointed to a target to get a “listener” to notice it, the listener might express puzzlement. Was the speaker pointing to a particular individual, to tree, to flowers that grew nearby, or the like? To clarify the target of the speaker’s point, the speaker had to invent a new gesture. In doing so, the speaker *disambiguated* the referent for the act of pointing. That gesture could have been the first word.

Over time, the articulatory apparatus of our ancestors evolved to the point where they could voluntarily produce the sounds of language. There were two advantages of vocal communication. It allowed our ancestors to use their hands for other tasks and to communicate in the dark.

As far as I'm aware, this hypothesis is the first to describe the evolution of words. The central feature of that transition was a vocabulary of voluntarily emitted conversational words, from animal communication to words. They supplemented the meager set of involuntary, unidirectional emotional signals that comprise animal communication. That change in the medium of communication could be regarded as the beginning of language.

Summary

Language, as we know it, evolved in stages. Words evolved before grammar. However, before our ancestors could produce words, they had to experience three non-verbal forms of communication. The first made it more likely that they would cooperate, rather than compete, when interacting with one another. The others entailed a strong emotional bond between an infant and her caregiver, as well as the ability to share attention to objects of mutual interest. These uniquely human abilities enabled our ancestors to communicate about objects of mutual interest. The first utterances, which arbitrarily were likely gestural (rather than vocal), were probably derived from pointing. If the target of the pointer were not clear, the pointer would have to create another gesture to disambiguate the referent of the earlier point. That gesture would qualify as the first word.

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Endnotes

ⁱⁱ Chesterton, 1912

ⁱⁱⁱ Rembaugle, Sue Sauage, Premack, Terrace, et al. 1979

^{iv} "New International Version Bible." (2011) Zondervan

^v "In the beginning was the Word, and the Word was with God, and the Word was God." John 1:1 (NIV)

^{vi} Darwin (1871) .

^{vii} I will discuss the basic features of animal communication, and how they differ from language, in Chapter 2.

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^{xiv} The few exceptions have focused more on the symbolic value of words than on the factors that led to their evolution.

^{xv} Berwick, R., & Chomsky, N. (2017, 01/11). Why only us: Recent questions and answers. *Journal of Neurolinguistics*, 43, 166–177. <https://doi.org/10.1016/j.jneuroling.2016.12.002> pp.90- 91.

^{xvi} The age of the earth is estimated to be at least 4 million years [Claire, P., Michael, G., & Wayne, S. (1956). Division of Geological Sciences. *Geochimica et Cosmochimica Acta*, 10, 236 to 237.]; at least 8 million species have evolved since life learned on earth [Mora, C., Tittensor, D., Adl, S., Simpson, A., & Worm, B. (2011). How many species are there on Earth and in the ocean? *PLoS Biology*. <https://doi.org/https://doi.org/10.1371/journal.pbio.1001127>].

^{xvii} Bickerton, D. (2014). *More Than Nature Needs: Language, Mind, and Evolution*. Harvard University Press. <https://doi.org/ISBN-13:9780674724907> p.33.

^{xviii} Within a particular species, that number rarely exceeds a dozen.

^{xix} There are approximately 7000 languages. Hammarström, H. (2015). Ethnologue 16/17/18th editions: A comprehensive review. .

^{xx} A first grade student knows at least 3500 words. White, T., Graves, M., & Slater, W. (1990). Growth of Reading Vocabulary in Diverse Elementary Schools: Decoding and Word Meaning. *Journal of Educational Psychology*, 82, 281–290. .

^{xxi} Number of languages ADD

^{xxii} Maynard Smith, J., & Szathmáry, E. (1995). The major evolutionary transitions. *Nature*, 374, 227–232. <https://doi.org/https://doi.org/10.1038%2F374227a0> .

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^{xxxii} Teaforde, M., & Ungar, P. (2000). Diet and the evolution of the earliest human ancestors. *Proceedings of the National Academy of Sciences*, 97(25), 13506–13511. .

^{xxxiii} The volume of a chimpanzee brain is approximately 350cc. Rilling, J. (2014). Comparative primate neurobiology and the evolution of brain language systems. *Current Opinion in Neurobiology*, 28, 10–14. .The volume of humane brain is approximately 1300 cc (Mora, et al. 2011).

^{xxxiv} *Homo erectus* appeared about 2 million years ago Antón, S. (2003). Natural history of *Homo erectus*. *American Journal of Physical Anthropology*, 122, 126–170. . They become extinct about 125 million years ago (Rizal, Y., Westaway, K., Zaim, Y., Van den Bergh, G., Bettis, A., Morwood, M., Huffman, F., Grün, R., Joannes-Boyau, R., Bailey, R., Westaway, M., Kurniawan, I., Moore, M., Storey, M., Aziz, F., Zhao, J.-x., Aswan, A., Sipola, M., Larick, R., & Ciochon, R. (2020, 01/16). Last appearance of *Homo erectus* at Ngandong, Java, 117,000–108,000 years ago. *Nature*, 577. <https://doi.org/10.1038/s41586-019-1863-2> .

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