Review Psikiyatride Güncel Yaklaşımlar-Current Approaches in Psychiatry 2023; 15(2):333-347
doi: 10.18863/pgy.1130222

On Language Cognition Relations and Evolution of Language

Dil Biliş İlişkileri ve Dilin Evrimi Üzerine

Fatma Ebru Köse[1]

[1]Aydın Adnan Menderes University, Aydın

ABSTRACT

One can understand the importance of language with its relation to mental activities such as memory and thinking. Language, a crucial human ability, has long attracted the attention of various theorists and philosophers. Language, by its nature, interacts with many biological, cultural and psychological factors. This article has drawn a general framework by bringing together the views from disciplines such as linguistics, psychology, anthropology, biology and neuroscience. On the one hand, while the theoretical opinions about language are included, on the other hand, language is discussed in the context of the changes we went through by separating from our common ancestor in the evolution process. When dealing with language, it is possible to talk about our differences from animals, the interaction of language with our cognitive processes and its organization in the brain. The views put forward by philosophers such as Plato and Descartes about the relationship between language and cognitions have expanded by Chomsky, Pinker, Dunbar and others on the evolution of language. In this article, evolutionary psychology, which strives to understand language and its relationship with cognitions, is emphasized by combining the data of modern evolutionary biology and cognitive psychology. Language is acquired quickly and without the intense need for learning experiences, thanks to innate schemas, suggests that evolution formed these schemas. According to another view, the influence of the environment and culture gains importance instead of innatism. In addition, different opinions on the evolution of language are briefly discussed. Discussion topics include triggers of language development in evolution. These are related to biological and cultural influences, influences of vocalization and hand gestures on language. When thinking about language and its evolution, it is inevitable to observe and examine cognitive processes and thought. Multidisciplinary studies can also provide important information about the evolution of language while trying to understand the complex relationship between language and cognition.

Keywords: Language, cognition, evolution, evolutionary psychology

ÖZ

Dilin önemi bellek, düşünme gibi zihinsel aktivitelerimizle olan ilişkisi çerçevesinde anlaşılabilir. İnsanın en önemli yetisi olan dil, uzun süredir çeşitli kuramcı ve filozofların ilgisini çekmiştir. Dil doğası gereği biyolojik, kültürel, psikolojik birçok faktörle etkileşir. Bu yazıda dil bilimi, psikoloji, antropoloji, biyoloji ve sinir bilimi gibi disiplinlerden gelen görüşler bir araya getirilerek genel bir çerçeve çizilmiştir. Bir yandan dil ile ilgili kuramsal görüşlere yer verilirken diğer yandan da evrim sürecinde ortak atamızdan ayrılarak geçirdiğimiz değişimler bağlamında ele alınmıştır. Dil ele alınırken en çok hayvanlarla olan farklılıklarımızdan, dilin bilişsel süreçlerimizle olan etkileşiminden ve beyindeki organizasyonundan bahsetmek mümkündür. Platon ve Descartes gibi filozofların dil ve bilişler arasındaki ilişki hakkında ortaya koyduğu görüşler, Chomsky, Pinker, Dunbar ve diğerlerinin dilin evrimi ile ilgili görüşleriyle genişlemiştir. Bu makalede, modern evrimsel biyolojinin ve bilişsel psikolojinin verileri bir araya getirilerek dili ve dilin bilişlerle olan ilişkisini anlama çabasında olan evrimsel psikolojiye vurgu yapılmıştır. Dilin doğuştan getirilen şemalar sayesinde hızlı bir şekilde ve öğrenme yaşantılarına yoğun bir ihtiyaç duyulmadan edinilmesi, bu şemaların evrimsel süreçte oluştuğu fikrini akla getirir. Bir diğer bakış açısına göre doğuştancılık yerine çevrenin ve kültürün etkisi önem kazanır. Ek olarak, dilin evrimi hakkındaki farklı görüşler kısaca ele alınmıştır. Tartışma konuları daha çok dilin evrimsel süreçteki gelişimini tetikleyen durumları içerir. Bunlar, biyolojik ve kültürel etkiler ile vokalizasyon ve el hareketlerinin dili etkilemesi ile ilgilidir. Dil ve evrimi hakkında düşünürken, bilişsel süreçlerle düşünceyi gözlemleyip incelemek kaçınılmazdır. Multidisipliner çalışmalar, dil ve bilişin karmaşık ilişkisini anlamaya çalışırken dilin evrimi hakkında da önemli bilgiler sağlayabilir.

Anahtar sözcükler: Dil, biliş, evrim, evrimsel psikoloji

Address for Correspondence: Fatma Ebru Köse, Aydın Adnan Menderes University Faculty of Humanities and Social Sciences Department of Psychology, Aydın, Türkiye **E-mail:** feates@adu.edu.tr
Received: 28.06.2022 | **Accepted:** 10.10.2022

Introduction

Language has a crucial role in human life. One of the features that distinguish humans from other living things is that they have the ability to speak and that they can use their minds in different ways in line with this ability. According to Ergenç (2000) language is a concept that "emerges as a result of a physiological, biological and social process that is considered a document of privilege". The concept of language has attracted the attention of numerous scientists from various disciplines. These scientists have developed many theories to understand the formation, development and evolution of language, especially in the last 60 years (Lieberman 1984, Pinker & Bloom 1992, Dunbar 1993, Chomsky 2002).

In this article, the views on language and cognition relations and the role of the evolutionary process in language are examined. In addition, the ideas of various philosophers, evolutionary scientists, psychology theorists and researchers who have made important contributions to the field of linguistics are included. In addition to these, the evolutionary development of language and the brain organization of language are discussed. The main purpose of this article is to summarize how the relations between language and cognition have been historically approached by various disciplines. Another aim of the article is to examine the place of cognitive functions while the biological evolution of language takes place, by including the views in the literature. This article does not aim to cover all the issues and debates in the field or the history of the field comprehensively.

The Relation of Language and Cognition

Language, by its nature, is intertwined with the mind, it is very difficult to separate the two from each other and it would be an erroneous approach. Just as our cognitions can be a product of language, our cognitive capacity enables us to use language. For example, the abstraction ability is thought to be an important cognitive trait that distinguishes humans from other animals (Bloom & Keil 2001). What enables people to use abstraction is the ability to use language and symbols. Abstraction and language are conceptually intertwined so it is difficult to separate them.

Psychology is one of the branches of science that deals with language. In psychology, especially the origin of language, its development and its relationship with cognitions are investigated. According to Chomsky (2002) language is essential for conceptualizing and interpreting thought processes. In this respect, linguistics and psychology should work together because their interests are common. It is appropriate to start with the ideas of psychology about language with the views of the German psychologist Wilhelm Wundt, who is considered the founder of experimental psychology and psycholinguistics. In the late 19th century, Wundt contributed to the linguistic debate about the structural and semantic development of words before sentences, created a tree diagram to analyze syntactic structure, and coined the term "holophrases" to denote children's one-word first words (Sihna 2007). According to Wundt, understanding and producing language takes place thanks to "internal" thought sequences. The verbal message is perceived, then the language-specific structured components are arranged and the message is phoneticized and transmitted to the other party. The listener who receives the message creates his/her thought sequence by following these steps in reverse (Segalowitz &Trofimovich 2012). In addition, Wundt distinguished meaning and language structure from knowledge (Brown & Lenneberg 1954). In this way, he emphasized the fact that different layers of language such as semantics, grammar and phonetics and their corresponding cognitive features could be examined separately and paved the way for experimental studies. In 1900, Wundt put forward the Wundertheorie (miracle theory) and stated that the language function is related to human nature and that the origins of language can be understood if the creation of man is understood (Mandler 2007). As mentioned later in the article, it is still a controversial issue in the field of modern evolutionary biology whether language emerged suddenly or as a result of some developments. Wundt also emphasized the sudden emergence of language a century ago (Mandler 2007). His views on this subject are discussed extensively in his work, Die Sprache (Language), the first volume of Völkerpsychologie (Ethnic Psychology) (Mandler 2007). Possibly, Wundt inspired Chomsky with his methods of examining language in these works and especially with his view that language is saltational.

Sir Frederic Bartlett, an important cognitive psychologist, thought it is appropriate to examine the relationship between language and memory in the natural environment. He had the participants read a story and asked them to remember it at certain intervals and rewrite it as they remembered it in various sessions. He observed that the participants restructured these rewritten stories according to the language they used and the culture they belonged to. In this research, Bartlett concluded that the coding and remembering of stories agree with the schemas that they have created before (Solso et al. 2007). From this point of view, it can be said that the

meanings and interpretations that emerge with the use of language also affect the recall (perhaps false recall) performances of individuals.

While examining the location of language in the brain, which is discussed in detail later, it is seen that there are some specialized regions of language in the human brain. Although these defined brain regions also anatomically exist in animals, they only perform language functions specific to humans in the human brain. For example, it is seen that these language-specific regions of the brain are activated when people are thinking, calculating, and solving problems, that is, talking to themselves to perform higher-level cognitive functions (Logie et al. 2003). When taken together, the relationship of language with our brain, that is, our cognitions gradually emerges.

The effect of imitation on language is also worth examining. Imitation is a cognitive function that includes the ability to imitate one's motor movements, emotional expressions, and bodily or vocal expressions (Rizolatti et al. 2001). Imitation plays an important role in language acquisition, especially in infancy. In comparison studies, it is observed that monkeys perform lower than expected in imitation skills (Custance 1995, Heyes 1998), while it is possible to observe that solely vocal imitation is excellent in some animals from which our common ancestor, such as the parrot, diverged many years ago. This topic is elaborated on in the Hand Gestures versus Vocalization section.

Working memory, another cognitive function, is a very suitable example in terms of revealing the relationship between language and cognitive capacity. This type of memory is a cognitive function that allows us to keep information from various modalities in our minds and to process this information (Baddeley 2003). Working memory determines the complexity of our sentences. As the sentence formed during communication gets longer, we need to keep the information it contains and the entire sentence in our minds. However, this capacity is not unlimited, on the contrary, working memory is limited. Therefore, working memory determines how many messages can be sent during communication, or how much of this message the receiver can remember and understand as a whole.

Category perception also is essential in language acquisition. Category perception, which is found in the auditory system of almost all mammals, may have become more specific in humans with articulation and auditory/acoustic skills (Anderson 2012). Lieberman and Mattingly (1985) consider hominids to have a skill that allows them to categorize vocal and silent sounds. Lieberman and Crelin (1971) showed that some of the vocal and silent sounds used by modern humans could also be used by Neanderthals.

Chomsky first suggested that the evolution of language was not gradual and that it could not be assumed that each trait was selected individually, but later he compromised from the idea by working with evolutionary biologists (Kerimoğlu 2021). Accordingly, two main concepts were created to examine the cognitive functions associated with language more systematically in the evolutionary context: The faculty of language-broad sense (FLB) and the faculty of language-narrow sense (FLN) (Hauser et al. 2002). FLB is a computational system that controls two or more organism-specific internal systems. These are sensory-motor and conceptual-intentional systems. These simply make it possible for humans to learn the language without any instruction. Other cognitive processes that are necessary but not sufficient for language are not included in the FLB. In addition, the ability to imitate is considered an important prerequisite of FLB (Hauser et al. 2002). FLN, which is part of FLB, is a stand-alone, abstract and linguistic accounting system. Although it is an independent system, it interacts with other systems. Evolutionarily human-specific features related to developing language are within the scope of the FLN. Chomsky creates an evolutionarily human-specific domain by defining the FLN (Kerimoğlu 2021). FLN takes a finite number of elements and generates infinite expressions. It is possible to talk about some physical features that affect the use of language that limit the FLN. For example, the air from our lungs determines the length of our sentences (Hauser et al. 2002).

One of the important views in cognitive sciences in the 21st century is that recursion, which enables the production of new words (including instances of the same phrase within a phrase), is unavailable to change and use by other systems in animals, but becomes available to humans. This allows people to generalize recursion, which is a part of FLN, to other problems. According to Hauser et al. (2002), although the FLB system is shared among most species, the FLN system has emerged in a human-specific manner in the evolutionary process. The best way to explain this is to reveal the differences and similarities by conducting comparative research involving all living things, rather than only working with chimpanzees as the creature that most closely resembles humans (Hauser et al. 2002). Considering that humans, like all other animals, are a part of nature which go through evolutionary processes, it is inevitable that there will be similarities (Aydın & Salman, 2021). However, some theorists oppose this idea (Pinker 1995, Chomsky 2014). Vyvyan Evans (2014), especially referring to Pinker's (2015) book "Language Instinct" with his book "The Myth of Language", strongly opposes Chomsky's view of universal grammar. According to him, one-third of the languages spoken in the world do not belong to a language

family, so it is false to talk about a universal language (Evans 2014). In addition, Evans, while accepting the neurobiological elements of language, argues that the act of language is experiential, not innate (Evans 2014). More importantly, he argues that each language can reveal different mental-perceptual processes, based on his research on the brain activity of people who speak different languages (Evans 2014).

Philosophers and Theorists Addressing the Relationship between Language and Mind

Language interests many disciplines such as linguistics, philosophy, biology, anthropology and neuroscience. The statements of Plato, who presents important views about language in philosophy, that thought is "man's dialogue with himself" and an "inner speech" reveal that he evaluates thought and language together (Altınörs 2010). Plato emphasizes that there is a difference between the sound of words and what is meant by the word (Nehring 1945). However, he states that language does not show the truth, that people may call a round object flat and this may not reflect the truth (Altınörs 2010). Human thought is dependent on language, according to Plato; however, the thought generated by language may not be a complete reflection of the real world. Aristotle, who followed in the footsteps of his teacher, had similar ideas. He made the oldest grammar analysis of Greek in his work Poetics (Householder 1995). However, Aristotle argues that not only thinking but also emotions that are a part of our mind such as desire, anger and joy will be affected by language (Altınörs 2010). In addition, he emphasizes that external speech is more error-prone than internal speech because it contains ambiguity (Altınörs 2010). From these views of Aristotle, the idea that each individual has his understanding and that people's minds are subjective can be deduced.

According to the theory of Augustine, a medieval philosopher, words are the subject of real knowledge, which is the object of sensory perception or reason (Ando 1994). A text is a written representation of speech, and a word simply means something real, whether written or spoken (Ando 1994). Augustine emphasizes the difference between things and signs. According to him, things are learned through signs (oral or written elements of language) (Thomas 2003). He also has important views on the relationship between language and cognitions. He concluded that language cannot keep up with the speed of thought and that it circulates and deflects thought (Altınörs 2010). These thoughts of Augustine point to "increased associations" and similar symptoms seen in psychological disorders such as bipolar disorder and schizophrenia. According to him, the deterioration of language is a reflection of the deterioration of cognitive processes.

In the Early Modern Age, Descartes attached great importance to language, seeing it as "the only sure sign of the existence of thought within us" (Cottingham 1995). He attributes the manifestation and occurrence of thought to the language skill found only in humans and emphasizes that there are great differences between the expression styles of humans and animals, with the assumption of "machine-human" (Altınörs 2010). He states that the differences that reveal the machine-human distinction will also reveal the differences between humans and animals (Altınörs 2010). He strongly opposes the idea that an animal can think and reason (Gunderson 1964). One of the differences that distinguish a machine from a human has to do with language. In Descartes' words, while all humans, including "craps, fools and fools", can speak, Descartes found it very remarkable that an animal cannot speak by nature, no matter how perfectly it is created (Altınörs 2010). However, today, if Descartes's thought is examined with evolutionary data, it can be said that there are differences in terms of the structures that are specialized to talk between humans and animals, that animals can communicate within their species, and sometimes even between species, but they do this in a different way than humans use speech and language. Descartes' philosophy dictates thought and language stem from the fact that one has a soul, which is not the product of evolution. However, Hobbes claims that language is the only human ability (Ross 1988). According to him, animals express their feelings and intentions with semi-language, while true language consists of what he calls “notes” representing images and notes representing quadratic notes (Ross 1988).

Descartes, like Plato, views language as a factor that enables thought to emerge but also emphasizes that language can be an obstacle (Altınörs 2010). Descartes, in his book "Principles of Philosophy", states that people pay attention to the word itself rather than its meaning and that people's attention to the words will be no different from the automatic reactions of animals (Altınörs 2010). He considers this an obstacle to thought. He defines a distinction between "ideas" and "thoughts" and argues that people's words should originate from thoughts, not ideas (Altınörs 2010). These views of Descartes are considered a mentalist view in the philosophy of language (Altınörs 2010). With this emphasis on understanding, he took a stance against the behaviorist movement in psychology. Linguists such as Chomsky adopted Descartes' language view (Cottingham 1995). In addition, Descartes' view of human will, which enables the creation of sentences in unlimited combinations from a limited number of words, also influenced Chomsky's views on generative grammar.

Lenneberg (1969), who is known for his saying "Language development in children is best understood in the context of developmental biology.", considered humans as a species while examining language. He defined six characteristic features of the language. These are 1. It is a behavior that exists in all cultures in the world. 2. Age of onset is similar in all cultures. 3. The strategy for acquiring language is the same for all babies in the world. 4. Regardless of its external form, it is essentially based on the same formal functioning. 5. Language has taken place in human history unchanged. 6. It is a behavior pattern that can be particularly impaired by limited brain lesions that can leave other mental and motor skills relatively unaffected (Lenneberg 1969). Lenneberg attributes the existence of these features in humans to the biological nature of language but states that this approach is a result of the developmental perspective, not the origins of the species perspective (Lenneberg 1969). According to Lenneberg, language depends on human cognitive characteristics, human cognition takes an active role and enables language to have receptive and transformative properties (Lenneberg 2019). He also objected to the biological view that prevailed at that time, denying that language originates from cognition. According to him, language is very important for us to learn about the human brain and cognitions (Lenneberg 2019).

J.L. Austin is a philosopher who has produced many ideas on language. Austin made a distinction between what speakers say and what they mean (Thomas 2003). According to Austin, we cannot simply accept the superficial value of the sentence, it is necessary to consider the meaning of the sentences for the speaker as well as their verbal meanings (Gardner 1985). According to him the neutral meaning of the sentence changes depending on who says what, in what context, and why (Gardner 1985). Austin emphasized that language should be handled meticulously in psychology studies. While language can be an objective concept, language also has a personal, subjective side.

Ludwig Wittgenstein, a philosopher of language, examines the logical structures of language. He argues that language enables us to obtain a picture of reality and that thought comes from language (Gardner 1985). Wittgenstein sees language as a way of understanding the world (Gardner 1985). According to him, language is a communal activity, it is introduced to the person by others and in this way, the person learns how to use the language (Gardner 1985). In this respect, Wittgenstein's hypothesis is similar to the Whorfian hypothesis, which will be discussed later, but Wittgenstein has a more sociological perspective.

Two Fundamental Views on the Origin of Language: Learning vs. Nativism

Nativism is a movement that advocates the view that most of our knowledge is universal and innate. Modular innatism is a variation of this trend. He claims that the mind consists of a set of interrelated innate modules, structures or limitations (Miller 2008). Modules are pre-programmed to respond to certain types of information (Miller 2008). The modular innate approach, in line with Darwin's theory of evolution, proposes that there is no need for triggering experience to learn a language (Miller 2008). For example, without teaching language at critical developmental stages, exposure to language alone may be sufficient to ensure normal language development.

Descartes, who had important ideas about human nature and the innateness of the mind, undoubtedly influenced many philosophers and scientists who came after him. For a period, he thought that knowledge, thoughts and experiences are acquired through the senses, then he devalues the senses and attributes thought and creativity to the mind. He argues that this is innate, it does not originate from experience (Gardner 1985). Locke has similar ideas. According to him, everything starts with perception but does not end with it. He examines the transition from simple thoughts formed by perception to complex ones. In this process the organism has abilities such as summarizing and generalizing (Gardner 1985). Similar to Descartes' view, according to Fodor, humans are born with a knowledge of language. Universal grammar is different from mathematical facts (Lowe 1995). However, unlike empiricists, Fodor thinks that this knowledge should at least be triggered by the environment (Fodor 2008). Fodor (1980) introduces the concept of language of thought and postulates that cognitive processes are computational manipulations of internal symbolic representations. In animals and machines such operations are purely formal or syntactic. Formal operations are operations specified without reference to such semantic properties of representations. Fodor believes that the semantic symbols of natural language depend on the representation of thought (Carston 1995).

In the 1960s Noam Chomsky argues that every human being is born with the ability to acquire and use language. He states that language is a cognitive ability specific to humans (Chomsky 2002). Three main ideas stand out in Chomsky's theory. The first of these is that the meaning of the sentence does not change even if the superficial structure of the sentence changes. Second, language is not a closed system, it is productive. Chomsky said, "Language is the process of free creation. The rules and principles of language do not change, but the way in

which they are formulated is made freely and in an infinite variety. Even the interpretation and use of words is a free creative process." His words clearly reveal his thoughts about the productivity of language (Chomsky 2003). The third view is that many features in the basic structure of language are common and innate (Solso et al. 2007). Chomsky, with this view, emphasizes that we do not have a grammatical system, but an innate schema in information processing and abstraction. While Chomksy considers language production and language comprehension processes as 'performance', he also emphasizes the 'competence' of the speaker and listener (Chomsky 2015). Chomsky also mentioned universal and special grammar. According to Chomsky, universal grammar is a generative grammar that emerges with an innate predisposition but is not learned. Special grammar, on the other hand, is the grammar rules belonging to a language spoken by a certain group of people (Chomsky 2001).

In the early 1960s, while Chomsky's views were spreading in linguistics, his work and nativist views on language also attracted the attention of scientists in other fields. One of the important psychologists influenced by Chomsky is George Miller. Miller was interested in the psychological dimension of Chomsky's transformational theory (Gardner 1985). Miller viewed language as a cognitive category system. This system is involved in the regulation and control of mental operations in areas such as the field of expression, persuasion, therapy, and education (Miller 1962). Although his efforts on this subject were not completely successful, he made important contributions to the field of psycholinguistics (Gardner 1985). Chomsky argues that not only language but also a large part of other mental skills develop with an innate predisposition (Chomsky 2008). Chomsky mentions the existence of a "language acquisition device" (LAD) that we are born with, emphasizing a mind that contains the rules of human language (Chomsky 2008). According to him, children do not learn the language from scratch, contrary to the view advocated by behaviorists, but they form the language rules used in their environment by using their innate "universal grammar" knowledge (Chomsky 2001, Evans 2004, Chomsky 2008). In this respect, language is not a learned behavior, it develops naturally just like an instinct or a biological organ (Evans 2004). Also, unlike his predecessors, Chomsky treats grammatical generalization as automation. This automation can be seen as a machine that creates sequences of words according to certain rules. Ironically, however, the implementation of many of Chomsky's ideas on computers fails (Gardner 1985).

B. F. Skinner, one of the leading figures of behaviorism, who has opposing views with these views of Chomsky, claims in his book Verbal Behaviour that language is learned by reinforcement like other behaviors (Gardner 1985). The behaviorist view completely ignores the productivity of language and sees language as a limited function. According to this view, our use of language will only be limited to what we have acquired through our learning experiences, which is not the case. Another problem associated with this view is that although children learning the language are not reinforced by their parents, they cannot explain their misuse, such as "tooths", which does not comply with the grammar rules at all. Chomsky was skeptical that theories explaining human behavior could also explain language and thought that Skinner's views were in the wrong direction (Chomsky 2008). Chomsky's generative grammar understanding, which reveals that an unlimited number of data can be produced from a limited number of data, and Skinner's views are opposed to each other. However, it would be wrong to reject behaviorism's views on language based on what has been said. There are also certain conditions in which the language is learned. For example, in a study by Guess et al. (1968), a person with intellectual disabilities is taught to use correct grammar rules through operant conditioning. On the other hand, although our close relatives, primates, appear to have structures that enable them to perform vocal articulation, both neurobiological and behavioral studies have shown a failure to operantly condition monkeys to change their species-specific calls (Jürgens 2002, Fitch 2010). These results indicate that non-human primates have little or no voluntary control over the structure of their vocalizations, but may have some acquisition through learning to a certain extent.

According to another perspective, language and biological maturation develop together by influencing each other. In this view, in contrast to innatism, the influence of the environment is more dominant. Edward Sapir, the pioneer of this perspective, examines culture, conceptualization and meaning (Gardner 1985). Lee Whorf, influenced by Sapir, developed this idea and added his name (Sapir-Whorf hypothesis) to the hypothesis he developed. According to Whorf, the mind would be amorphous without language (Nerlich & Clarke 2007). One of the important concepts of the Sapir-Whorf hypothesis is that language is relative, and the other is that language affects thought and perception (Pederson 2007). According to Whorf, our stream of experience is segmented by cultural, perceptual, and bodily-based patterns of meaning (Nerlich & Clarke 2007). Therefore, there are differences arising from the nature of the language. For example, a representation can mean different things to people who speak different languages and come from different cultures. Whorf has studied the Native American language and emphasizes that there can be no precise translation from one language to another (Whorf 2012). Because while there is no distinction between nouns and verbs in one language, there may be no

past, present and future tenses in another. Moreover, according to data from anthropological studies, cultures can differ quite a lot even in naming colors. The psycholinguist Roger Brown and his student Eric Lenneberg (1954) were interested in how cultures' specific separation of the color spectrum affects the classification and recognition of certain color tones in that culture. According to the Sapir-Whorf hypothesis, a person's conceptualization of the world includes specific elements and the concepts of the culture to which they belong (Kottak 2002). Brown and Lenneberg (1954) wanted to test this hypothesis. The reason for using colors in their works is that colors can be defined objectively independent of culture and many cultures have different color meanings according to intercultural records. The study is conducted with only native speakers of English. In the study, the group in which 24 colors that can be coded are asked to name these colors, while the other group, who is shown a series of colors for a short time, is asked to indicate which of the many color tones is shown or not. The results support the Sapir-Whorf hypothesis. Participants remember colors that can be coded better. Colors with an American English counterpart are easier to recognize by participants. Interestingly, although people do not differ in seeing and distinguishing colors in terms of physiological characteristics, they can remember colors better in their language. The fact that language affects people's perception is evidence of the effect of culture on language. For example, Inuit people use many words related to snow (Solso et al. 2007). However, when evaluating the data, we should not think that language changes our perception, and we should also consider the importance of experience. According to Whorf, the words of language and thought are aspects of a single system. This thinking is quite different from the more modular view of language processing that predominates in current psychology and linguistics (Pederson 2007).

Evolutionary Psychology's Perspective on Language and Cognitions

Darwin's views on evolution influenced psychology as well as biology. According to Buss (2005), “the evolutionary perspective is a revolutionary paradigm shift for psychology and has spread to all fields of psychology”. Darwin emphasizes that psychological processes are also affected by evolutionary mechanisms in his work Origin of Species (2005) with these words: “Psychology will rise firmly based on the necessarily gradual acquisition of all faculties and all mental faculties. This will shine a vivid light on the origin and history of man”. Emotions and cognitive traits have gone through natural selection, just as the sense of sight is formed step by step in the evolutionary process. Based on these considerations, evolutionary psychology is a sub-discipline of psychology that proposes that the mind is formed by following similar paths as our biological evolution. Evolutionary cognitive psychology, on the other hand, is based on the idea that cognition, which consists of functions such as thinking, language, memory, and perception, can best be understood within the context of physical and social evolution (Solso et al. 2007). The most important component of evolution is "change". Changes occur through random mutations and natural and sexual selection. Just as the instinct to learn some behaviors in animals has evolved evolutionarily, the instinct to learn a language may also have developed in humans (Tooby & Cosmides 2005). According to Jerry Fodor, the mind should not be a single, general-purpose program, but a collection of many special-purpose programs (modules), each with its own rules (Fodor 2008). John Tooby and Leda Cosmides took Fodor's concept of the module and transferred it to evolutionary psychology (Evans 2004). They argue that the mind exists for more specialized purposes, not for general purposes. In connection with this point of view, they aimed to examine how the different parts (modules) of the mind evolve (Tooby & Cosmides 2005). The modularity view opposes generalizations about the mind, arguing that the mind consists of modules, each with its development and standard operations. Tooby and Cosmides (2005) especially emphasize the difference between spoken language and writing and reading, and they state that spoken language can develop spontaneously without much need to be taught, but the reading and writing process cannot develop without an educational process. Chomsky also adopted the modularity view of language and thought that the mind consists of special systems (Gardner 1985). Also, according to Pinker and Jackendoff (2005), “The argument that language is designed for internal monologues rather than communication fails to explain why languages are paired with sounds and meanings and must be learned from a social context”. With these words, the researchers emphasize that human evolution does not only serve cognitive purposes but also has a social side. When we bring these views together, it is seen that it may be more appropriate to examine the development of language, which is a function of the mind, within an evolutionary framework.

Evolution of Language

Why and how language emerges, especially in humans, is a subject that is still debated and continues to attract attention. According to the latest archaeological studies, early Homo sapiens was found in Morocco about 280-350 thousand years ago (Hublin et al. 2017). Picturing 300,000 years ago is important for us to understand the evolution of language, the most important communication tool used by humans. Our primate common ancestors

lived in the Great Rift Valley (the region from northern Ethiopia to Mozambique) in East Africa, which consists of vast forests with tall trees (Stringer & Galway-Witham 2017). This valley was split in two by a great earthquake causing separation in hominid groups. Thus, our ancestors descending into savannas faced many adaptive problems. Our common ancestor, who previously escaped from predators by climbing trees or jumping from one tree to another, may have been vulnerable when he landed on the savannahs and needed to develop a warning system (Demirsoy 2011a). It is possible that our ancestors first developed a tool that we can define as a sound-based language to provide the communication necessary for survival among themselves.

How language emerges in humans is still a controversial issue in the scientific world. These discussions on the evolution of language proceed through three main themes (Hauser et al. 2002). The first of these is that language is shared by all species or is unique to humans. Of course, animals can communicate within and between species, and this communication is sometimes more effective than humans. For example, animals can exchange vitally important short and simple messages, using less energy by releasing a scent or using a single chirping. In contrast, people can relay complex messages to each other in almost endless combinations. The part that is difficult to understand evolutionarily is how these differences came about in the course of evolution. Researchers following in Darwin's footsteps focus on similarities and differences between us and primate species, based on the idea that we share similar language features with many primate species before we were separated from a common ancestor (Kerimoğlu 2016). Hauser et al.'s (2002) broad and narrow view of language faculties emphasizes the existence of distinct language faculties shared with animals and unique to humans. The second issue is whether the evolution of language is gradual or incremental, that is, a sudden and massive mutational change from one generation to the next (saltational). Gradual evolution is in line with Darwin's theory of evolution but has difficulty explaining the gap that includes large differences between species. By contrast, the other explanation, potentially advocating single-step speciation, may provide a clearer explanation for why humans have high-level language abilities, but struggles to provide sufficient paleoanthropological evidence for how this happened. Chomsky does not oppose the theory of evolution but considers it insufficient to explain the evolution of language (Chomsky 1988). In addition, he defends the view that language emerged out of nowhere, like counting skills, and emphasizes that not every feature can be selected (Chomsky 1988). However, Pinker (1995) completely opposes this view, arguing that language occurs gradually in the process of natural selection. Today, although the debate continues, the advocates of gradual evolution are in the majority (Kerimoğlu 2016). The last and third controversial issue is continuity versus exaptation. Communication systems that exist according to continuity have developed and reached their present position. This approach is based on Darwin's theory of evolution. According to this, language was formed by natural selection as a result of selection pressures created by nature and the environment. The pressures mentioned can be biological or cultural (Kerimoğlu 2016).

Pre-adaptation is when features that emerged in the evolutionary process, had a specific function or did not occur directly by natural selection, then fulfil other functions (existing roles) (Gould and Vrba 1982). An example of pre-adaptation is the appearance of feathers of birds which are primarily evolved for heat adaptation and then later used for flying. According to this approach, language emerges from pre-adaptations of physical characteristics such as tool making, cognitive characteristics such as reasoning and memory, or cultural characteristics such as social relations. It is very difficult for a new complex system such as language to suddenly emerge as a result of the evolutionary process. In addition, the pre-adaptations that contribute to the emergence of language are not only physical, many of the cognitive functions are necessary for the development of language. One of these cognitive functions is the ability to use symbols, that is, to combine certain sounds and movements with certain concepts and perceptions. Having a large memory capacity for different sounds and concepts and being able to represent these concepts in the mind are other important cognitive functions. Apart from these, having joint attention and eye tracking (following the gaze), understanding that other people also have thoughts and intentions (metacognition), and being able to imitate movements are social-cognitive functions required for successful communication. According to Tomasello (2007), who examines the relationship between language and cultural evolution, the primary cognitive ability required for people to use language is directing and sharing attention. From the age of one, the child learns the expressions of adults, tries to produce them, and in the process infers language-specific features from the words. As cognitive and social development continues, they produce abstract categories and schemes (Tomasello 2007). In summary, it is not clear whether language emerged through typical natural selection processes or separate evolution of other traits. Kerimoğlu (2016) explained this situation as follows: “The brain, speech organs, syntax, semantics, etc. The evolution of traits may have occurred differently. There is not enough evidence to say that each evolved in the same way. Determining which of these features of language and how natural selection works is one of the main concerns today.”

Other Important Discussion Topics on the Evolution of Language

Cultural Evolution vs. Biological Evolution

One of the main conflicts about the evolution of language is whether language adaptations are biologically or culturally ignited (Christiansen & Kirby 2003). In the previous chapters of the article, Chomsky's view of universal language and the concept of LAD were briefly explained. In fact, with these concepts, Chomsky and his followers emphasize the biological processes of language evolution. The universality of some language features, the inability of behaviorists to provide adequate explanations for language acquisition, the fact that all children similarly learn the language, and the existence of a complex relationship between mental abilities and language can be presented as evidence that language emerges biologically, not learning (Kerimoğlu 2016). However, serious objections were made to theorists who defended internal grammar (See Kerimoğlu 2016). Chomsky's views changed in the following years, and in his study with Hauser and Fitch, he favored the idea of language evolution by using the distinction between broad sense/narrow sense language competence (Hauser et al. 2002). Another perspective on the relationship between cultural processes and biological evolution belongs to Robin Dunbar (1993, 1998). With an interesting approach, Robin Dunbar (1993, 1998) aimed to examine biological evolution and cultural evolution together by dividing the size of the neocortex by the size of the group. According to Dunbar's social brain hypothesis, the size of the groups is limited by the information processing capacity of the primate brain, and the cerebral cortex, which is also called the neocortex, plays an important role in this respect (Dunbar 1998). These limitations may be related to recognizing and interpreting visual signals, facial memory, remembering the relations, manipulating information about relationships, or understanding the emotional states of others (for a detailed review, see Dunbar 1998). At the same time, Dunbar suggested that based on correlations between social group size and neocortical size, Homo erectus developed its vocal capacities compared to monkeys (Dunbar 1993). He found that the larger the neocortex of the species, the larger the group. It has been found that the average number of people in a group that includes regular social relationships in humans is about 150 (Dunbar 1998). Living in large groups makes sense for humans because they are physically more fragile compared to other animals. Therefore, living in a group protects from external threats. Our ancestors may have needed to live in large groups while struggling on the African plains. In addition, animals care for each other as an attachment behavior. In all primate communities, grooming (e.g. removing lice from the fur) is used to establish and maintain social bonds. The larger the primate group, the longer the average time each member cares for each other. Given the group capacity of 150 people, for everyone to care for each other, they would have to devote 40% of their time to caring, which is highly unlikely. According to Dunbar's social gossip hypothesis (1996), the language made it possible for Homo groups to make their social bonding processes more efficient. The process that started with vocal grooming first turned into speech and gossip. From this point of view, it was thought that language did not exist to label objects (Dunbar 1996). Language creates a great advantage by increasing cohesion within the group and providing information about group members. Since gossip can be made with many people, it is possible to get information about the behavior of other individuals in the group as well as the person being gossiped about, even before meeting them. Thus, it becomes possible to be prepared for threats from within the group and to decide with whom to cooperate. In addition, time is left for important tasks such as hunting and gathering instead of caring behavior. Similarly, Pinker and Bloom (1992) emphasized the importance of getting information about other individuals in a group of interdependent and cooperative individuals.

As people's environment improved, the objects they accessed increased, and thus, variations in language emerged. In other words, the language continued to develop and diversify with different dimensions. We have a complex structure that allows us to meet cultural needs or an almost unlimited language production ability that allows us to explain abstract concepts. Facing a global drought thought to have arisen around 12,000 years ago, humans may have had to change some of their behaviors to survive. For example, according to Demirsoy (2011b), people started to gather around a limited number of water supplies to meet their needs. This new form of behavior has brought a different socio-cultural life with it. Since people can socialize more quickly, there has been an increase and diversification in their cultural exchanges (Demirsoy, 2011b). Ultimately, with the development of trade, the need to regulate human relations arose, which led to the emergence of written language (Demirsoy 2011b). From this point of view, the language used by humans and animals for communication has provided quite different possibilities.

The Origin of Language: Hand Gestures Against Vocalization

Language has emerged as a result of the physiological and neuropsychological changes that humans have

undergone for over 2 million years (Özbek 2007). There are two important structures in the emergence of sound: The larynx and pharynx. The pharynx is a tube-shaped, muscular organ that starts from the larynx and includes the oral and nasal cavities and takes part in respiration. The larynx, which has cartilages, membranes and ligaments in its structure, vibrates the vocal cords with the effect of the airflow carried by the lungs and trachea and creates speech. Lieberman and Crelin (1971) emphasize that vocal and silent sounds are formed by different functions of anatomical structures such as the larynx and supralaryngeal vocal tract. In one of their studies, the authors showed that the airways and supralingeal voice apparatus, which they reconstructed based on the skull structures of a newborn and a Neanderthal, were similar (Lieberman & Crelin 1971). Based on their anatomical models, they revealed that Neanderthals could not produce all the vocal and silent sounds that modern humans can use today. However, they also stated that even this is more than non-human primates (Lieberman & Crelin 1971). However, it should not be forgotten that according to recent genome studies, Homo Sapiens and Neanderthal species share approximately 99.9% of their genomes, and especially 1% of the genome of European Homo Sapiens is shared with Neanderthals (Kerimoğlu 2019). Lieberman (1984) claimed that hominids could speak certain vowels thanks to the lowering of the larynx about 350,000 years ago (Macneilage and Davis 2005). Although this feature creates the danger of suffocation, it has evolved by natural selection (Peterson 2009). This suggests that language has great survival advantages. Any substance that escapes or gets stuck in the pharyngeal cavity can cause suffocation as it will block the air passing through the larynx. There have been some adaptive structural changes that reduced the likeliness of suffocation. The oral cavity and the pharynx is enlarged, and the larynx has shifted downwards (Özbek 2007). As a result of these changes, the mobility of the tongue has increased and human-specific sound production skill has emerged. The structure of the larynx is considered a pre-adaptation (Hauser et al. 2002). Although what triggers or initiates this process is still debated, the views mostly focus on bipedalism and dietary change. While bipedalism has an effect in terms of making the head and neck structure suitable for speech, the fact that it is possible to reach foods with high nutritional value such as nuts and bone marrow together with tool making has created the necessary pre-adaptations by enabling the brain to reach higher energy (Tallerman & Gibson 2012).

Donald (1994) suggested that the development of hominids' imitative (mimetic) expression skills may be an early evolutionary precursor to the development of language (Macneilage & Davis 2005). Accordingly, the general imitation skills that started with Homo Erectus are a skill that developed before language and served other purposes than language. It started with tribal rituals that emerged as a result of selection pressures to ensure group integrity, and it manifests itself with dance and sports in modern people. It is likely that these skills later developed into voice imitation. This idea is supported by the discovery of mirror neurons, which are activated by imitation of movement (Rizzolatti et al. 2000). In addition, brain regions corresponding to Broca's area in primate species such as chimpanzees and macaques are associated with complex hand movements and sensorimotor learning (See. Binkofski & Buccino 2004) and be activated in the control of mouth and tongue movements (Petrides et al. 2005). According to MacNeilage and Davis's (2005) frame/content (F/C) theory, vowel-consonant antecedent syllables appeared in the first spoken language and can be observed in newborns today. The formation of these vowel-consonant syllables started with the basic mouth and tongue movements related to eating-drinking in early hominids, and then the variations of vocalization were added to this (MacNeilage & Davis 2005).

Some researchers oppose the idea that language is formed as a result of vocal development. Givon (2002) thought that early visual movements and gestures may have developed before vocal-auditory skills. Rizolatti's (1996) findings on mirror neurons are more directly related to hand gesture imitation than other studies. In the aforementioned study, it was revealed that the premotor cortex areas of monkeys were activated while they were watching hand movements. With the emergence of bipedalism, the freeing of hands, the adaptation of the visual and motor systems to this change, and the development of mirror neurons, hominids began to plan their behavior and advanced this planning skill to communication using gestures (for a detailed explanation, see MacWhinney 2002).

Discussions about language evolution are not limited to those outlined above. There are also discussions about the emergence of language in human history (Kerimoğlu 2016). There are hypotheses based on other factors such as hunting, tool making, partner contract, rituals, music and song, mother-infant communication and sexuality among the reasons for the emergence of language (For a detailed review, see Kerimoğlu 2016). However, these theoretically have less scientific support than the discussion topics mentioned above.

Contribution of Neuroscience on the Relationship between Language and Cognition

The complexity of human cognitions and their structure is recognized by everyone, but mapping our cognitions

on the brain is even more complex. Discovering this is important for many disciplines, but no single discipline is capable of solving this puzzle on its own. The key to solving the puzzle is in multidisciplinary studies. In the previous sections of the article, various views and theories from the fields of psychology, biology, anthropology, ethology, philosophy and linguistics were mentioned. However, the data of neuroscience, which has developed rapidly in recent years, should not be overlooked.

The conditions necessary for the emergence of language are quite complex. For example, in addition to the mouth, tongue and larynx structure that makes vocal expression possible, the cognitive functions that will manage this structure must also be formed. As Chomsky (2002) emphasized, language is a species-specific, inherited cognitive trait that requires a brain, a physical structure specialized for language. From this point of view, it can be predicted that the brain will undergo the same changes that language has undergone during evolution. While the brain capacity of the Australopithecine species was 400-525 cc, it increased to 500-725 cc in the early Homo species (Tallerman & Gibson 2012, see Kerimoğlu 2022 for a detailed table). This change in the volume of the brain is thought to be the development of the cortex, and the areas responsible for language are also part of the cortex. In addition, the possibility of language acquisition in individuals with pathologically smaller brain volumes suggests that language is not directly related to brain volume and encephalization. The development of the brain is probably a preparation for the formation of language. The existence of pre-adaptations before the emergence of language was accepted in the literature (Macneilage & Davis 2005). The development of language started with Homo Sapiens 40,000 years ago. Demirsoy (2011a) stated that there may be an active speech in the Cro-Magnon subspecies, which has a common ancestor with Homo Sapiens but later split into different branches and the population is concentrated in France. In terms of timing, it showed between 40,000 and 45,000 years. Unfortunately, in the paleoanthropological fossil and skull endocast (internal mold) examinations, which could not give an idea about the brain structure, sufficient information could not be reached to confirm. However, thanks to the contributions of molecular biology, it has been possible to examine genetic similarities and differences (see Hauser et al. 2014). Another approach used to study the evolution of language is the comparative method. In this method, the language skills of humans and animals (especially primates and other mammals) are examined comparatively based on empirical data. Lieberman and Crelin (1971) suggested that the Neanderthal anatomical structure could not produce a sufficient variety of sounds to use the language, but based on the skull structure, the brain structure might be sufficient to generate speech signals using existing sounds.

While examining the concept of language and its relationship with cognitions, the brain and its functions should also be taken into account. Many scientists like Chomsky point out the importance of understanding how language is produced, acquired and developed (Chomsky 2008). However, the relationship between the brain and language is far from simple. It is not possible to give a definite answer to the question of whether language emerged because brain areas related to language developed, or whether the emergence of language functions developed the brain. Kerimoğlu (2022) stated that the answer to this question is that the evolution of the brain and language takes place “together and interactively”.

The first views on the formation of language function in the brain were expressed by Joseph Gall. Gall determined the location of language and other intellectual behaviors on the skull based on his observations and said that the anterior parts of the brain may be related to language (Zola-Morgan 1995). Paul Broca, with his pathological examinations, showed that the language impairments observed in patients with aphasia are caused by damage in the left cerebral hemisphere (Gardner 1985). Wernicke, a neurologist, discovered that patients with injuries in the left temporal region have problems in understanding language (Gardner 1985). The information heard or read follows a certain path in the brain. The Wernicke area provides the understanding of the heard words and the production of meaningful speech (Carlson 2011). Language does not emerge as a result of the study of these two fields alone. Language is intertwined with memory and enables the recognition of words and sounds in memory (Carlson 2011). In Broca's area, the first step of speaking is performed. Broca's area is involved in the pronunciation and production of words, and grammatical knowledge is reflected in speech through this area (Carlson 2011). Various studies have been conducted to examine whether these areas identified in humans also exist in species with which we share common ancestors. For example, Spocter et al. (2010) found similarity between humans and chimpanzees in terms of neuron number and left-sided asymmetry, while Gil da Costa et al. (2006) detected activation in human perisylvian language areas during species-specific calls in macaque monkeys. In addition, fossil evidence points to the existence of Broca's area and frontal areas important for language function in Homo Rudolfensis (Holloway et al. 2009). Clear boundaries drawn about such brain regions and functions point to the idea that language is localized in the brain. However, some researchers support the holistic view, saying that the functioning of the brain cannot be reduced to regions. For example, Hughlings Jackson emphasized that the localization of the symptoms does not mean that the

function will be the same, and stated that many functions work together in series or parallel for the emergence of language function and that they cannot have definite boundaries in the brain (Gardner 1985). According to Kerimoğlu (2022), the scientific world has not yet fully defined the biological and genetic structures related to language, and the evolutionary history of the defined areas has not been revealed yet. Despite this, advances in neuroscience and evolutionary biology allow us to access more and more information on this subject.

Conclusion

The desire for communication in humans is a major driving force in the evolution of language. Because language has ensured survival by allowing people to transfer dangers and opportunities to each other. In addition, the language carried through culture has significantly affected people's cognitive and cultural activities by providing the transfer of knowledge. Language has simplified abstract representations by enabling the realization of important cognitive functions such as planning for the near and distant future and abstract thinking. In this way, it shaped thinking and the structure of memory. These changes, which occurred with the transfer of language to genetic codes during the evolution process, became permanent and became an inseparable part of human beings. Understanding this part of humans will contribute to an understanding of human nature by providing answers to many questions.

It can be thought that ideas and theories on the evolution of language can only come from the field of linguistics. In this article, language and its evolution are examined by presenting views and findings from various fields. Thus, a window was opened for a multidisciplinary approach in the field of language. The evolution and structure of language can only be understood when the unique perspectives and backgrounds of many fields are brought together. Understanding how our brains work, the impact of language on our cognitive processes, and the evolutionary process require the involvement of biology, anthropology, linguistics, psychology, neuroscience, and even computer science. It is very difficult to give scientifically satisfactory answers to these questions from a single discipline. The contributions of neuroscience to the organization of language in the brain are undoubtedly invaluable. Thanks to the developing technology, it may be possible to support these data with brain imaging studies. These advances are capable of answering many of the researchers' questions about language. It may also be possible to embody cognitive processes that progress and interact with language with well-planned experimental paradigms through imaging studies.

Based on the interaction between language and cognition, many studies can be conducted on disease models in the field of psychology in the future, and psychological disorders in which language is impaired can be determined and their causes can be investigated. Using the data, psychologists can obtain a wide range of information related to certain cognitive functions and memory, just like Broca and Wernicke's information about brain structure. However, without the contributions of evolutionary biology and evolutionary psychology, the results will be incomplete. There are two important ways to understand the origin story of human language. The first is to understand the evolution of biological factors such as brain development, and mouth and tongue structure, and the second is to examine hypotheses about the evolution of the human mind, i.e. cognitive functions (including culture from an evolutionary psychology perspective). Because the formation of language in the evolutionary process occurs with the interaction of these two basic processes.

References

Altınörs SA (2010) Düşünce ile dil arasındaki ilişkiye Descartes'ın yaklaşımı. Erciyes Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 28:389-401.

Anderson SR (2012) The role of evolution in shaping the human language faculty. In The Oxford Handbook of Language Evolution (Eds M Tallerman, KR Gibson):361-369. New York, Oxford University Press.

Ando C (1994) Augustine on language. Revue d'Etudes Augustiniennes et Patristiques, 40:45-78.

Aydın Ö, Salman RC (2021) Üretici dilbilim çerçevesinden dilin evrimi: eleştirel bir değerlendirme. Madde, Diyalektik ve Toplum, 4:66-76.

Baddeley A (2003) Working memory and language: An overview. J Commun Disord, 36:189-208.

Binkofski F, Buccino G (2004) Motor functions of the Broca's region. Brain Lang, 89:362-369.

Bloom P, Keil FC (2001) Thinking through language. Mind Lang, 16:351-367.

Brown RW, Lenneberg EH (1954) A study in language and cognition. J Abnorm Soc Psycholo, 49:454-462.

Buss DM (2005) Introduction: The emergence of evolutionary psychology. In The Handbook of Evolutionary Psychology. (Ed DM Buss):xxiii-xxv. New Jersey, John Wiley & Sons, Inc.

Carlson N (2011). Davranışın Nörolojik Temelleri: Fizyolojik Psikoloji, 8th ed. (Çeviri Ed. M Şahin), Ankara, Nobel Akademik Yayıncılık.

Carston R (1995) Language of thought. In Concise Encyclopedia Of Philosophy Of Language. (Ed PV Lamarque):68-70. Exeter, Pergamon.

Chomsky N (1988) Language and Problems of Knowledge: The Managua Lectures (Ed. SJ Keyser) Cambridge, MA, London MIT Press.

Chomsky N (2001) Dil ve Zihin (Çev. A Kocaman). Ankara, Ayraç Yayınevi.

Chomsky N (2002) On Nature and Language (Eds. A Belletti, L Rizzi). Cambridge, Cambridge University Press.

Chomsky N (2003) For Reasons of State. London, Penguin Books.

Chomsky N (2008) The Essential Chomsky (Ed. A Arnove). New York, The New Press.

Chomsky N (2014) Dilin Mimarisi (Çev. İK Bayırlı). İstanbul, Boğaziçi Üniversitesi Yayınevi.

Chomsky N (2015) Aspects of the Theory of Syntax, 50th ed. Massachusetts, MIT press.

Christiansen MH, Kirby S (2003) Language evolution: consensus and controversies. Trends Cogn Sci, 7:300-307.

Cottingham J (1995) Descartes, René. In Concise Encyclopedia Of Philosophy Of Language (Ed PV Lamarque):480. Exeter, Pergamon.

Custance DM (1995) Social learning and imitation in human and nonhuman primates (Doktora tezi). St. Andrews, University of St. Andrews.

Darwin C (2005) Türlerin Kökeni, 6th ed. (Çev. S Belli). Ankara, Onur Yayınları.

Demirsoy A (2011a) Yaşamın Temel Kuralları, 22nd ed. Ankara, Meteksan A.Ş.

Demirsoy A (Aralık 2011b) İnsanın evrimi. Ders notu, Ankara, Hacettepe Üniversitesi.

Dunbar RIM (1993) Coevolution of neocortical size, group size and language in humans. Behav Brain Sci, 16:681-735.

Dunbar RIM (1996) Grooming, Gossip and The Evolution of Language. London, Faber and Faber.

Dunbar RIM (1998) The social brain hypothesis. Evol Anthropol, 6:178-190.

Dunbar RIM (2003) The social brain: mind, language, and society in evolutionary perspective. Annu Rev Anthropol, 32:163-181.

Ergenç I (2000) Dilin beyindeki organizasyonu ve konuşmanın gerçekleşmesi. In Multidisipliner Yaklaşımla Beyin ve Kognisyon. (Eds S Karakaş, H Aydın, C Erdemir Ç Özemsi):113-126. Ankara, Çizgi Tıp Yayınevi.

Evans D, Zarate O (2004). Evrimsel Psikolojiye Giriş, 1st ed. (Çev. H Çetinkaya). Ankara, Türk Psikologlar Derneği Yayınları.

Evans V (2014) The Language Myth: Why Language Is Not An Instinct. Cambridge, Cambridge University Press.

Fitch WT (2010) The Evolution of Language. Cambridge, Cambridge University Press.

Fodor JA (1980) Methodological solipsism is considered as a research strategy in cognitive psychology. Behav Brain Sci, 3:63-109.

Fodor JA (2008) The modularity of mind: An essay on faculty psychology. In Reasoning Studies of Human Inference and Its Foundations (Eds JE Adler, LJ Rips):878-914. Massachusetts, MIT Press.

Gardner H (1985) The Mind's New Science. New York, Basic Books.

Gil-da-Costa R, Martin A, Lopes MA, Munoz M, Fritz JB, Braun AR (2006) Species-specific calls activate homologs of Broca's and Wernicke's areas in the macaque. Nat Neurosci, 9:1064-1070.

Givon T (2002) The visual information-processing system as an evolutionary precursor of human language. In The Evolution of Language Out of Pre-Language (Eds T Givon ve BF Malle):3-50. Philadelphia, John Benjamins Publishing Company.

Gould SJ, Vrba ES (1982) Exaptation—a missing term in the science of form. Paleobiology, 8:4-15.

Guess D, Sailor W, Rutherford G, Baer DM (1968) An experimental analysis of linguistic development: The productive use of the plural morpheme. J Appl Behav Anal, 4:297-306.

Gunderson K (1964) Descartes, La Mettrie, language, and machines. Philosophy, 39:193-222.

Hauser MD, Chomsky N, Fitch WT (2002) The faculty of language: what is it, who has it, and how did it evolve? Science, 298:1569-1579.

Hauser MD, Yang C, Berwick RC, Tattersall I, Ryan MJ, Watumull J, et al. (2014) The mystery of language evolution. Front Psychol, 5:401.

Heyes CM (1998) Theory of mind in nonhuman primates. Behav Brain Sci, 21:101-114.

Holloway RL, Sherwood CC, Hof PR, Rilling JK (2009) Evolution of the brain in humans–Paleoneurology. In Encyclopedia of Neuroscience. (Eds MD Binder, N Hirokawa, U Windhorst):1326-1334. Berlin, Springer.

Householder FW (1995) Aristotle and the Stoics. In Concise Encyclopedia Of Philosophy Of Language (Ed PV Lamarque):475-480. Exeter, Pergamon.

Hublin JJ, Ben-Ncer A, Bailey SE, Freidline SE, Neubauer S, Skinner MM, et al. (2017). New fossils from Jebel Irhoud, Morocco and the pan-African origin of Homo sapiens. Nature, 546:289-292.

Jürgens U (2002) Neural pathways underlying vocal control. Neurosci Biobehav Rev, 26:235-258.

Kerimoğlu C (2016) Dilin kökeni arayışları 1: Dilin kökeniyle ilgili akademik tartışmalar. Dil Araştırmaları, 10:47-84.

Kerimoğlu C (2019) Dilin kökeni arayışları 4: Neandertallerin dili var mıydı?. Dil Araştırmaları, 13:7-53.

Kerimoğlu C (2021) Chomsky'nin problemi: dilin evrimi. Çukurova Üniversitesi Türkoloji Araştırmaları Dergisi, 6:598-614.

Kerimoğlu C (2022) Dilin kökeni arayışları 5: Beyin ve dil. Dil Araştırmaları, 16:21-37.

Kottak CP (2002) Antropoloji: İnsan Çeşitliliğine Bir Bakış (Çev. SN Altuntek). Ankara, Ütopya Yayınevi.

Lenneberg EH (1969) On explaining language. Science, 164:635-643.

Lenneberg EH (2019) A biological perspective of language. In Readings in Modern Linguistics: An Anthology (Ed. B Malmberg):344-358. Stockholm, De Gruyter Mouton.

Liberman AM, Mattingly IG (1985) The motor theory of speech perception revised. Cognition, 21:1-36.

Lieberman P (1984) The Biology and Evolution of Language. Massachusetts, Harvard University Press.

Lieberman P, Crelin ES (1971) On the speech of Neanderthal man. Linguistic Inquiry, 2:203-222.

Logie RH, Venneri A, Della Sala S, Redpath TW, Marshall I (2003) Brain activation and the phonological loop: The impact of rehearsal. Brain Cogn, 53:293-296.

Lowe EJ (1995) Language, metaphysics, and ontology. In Concise Encyclopedia Of Philosophy Of Language (Ed PV Lamarque):11-12. Exeter, Pergamon.

Macneilage PF, Davis BL (2005). The evolution of language. In The Handbook of Evolutionary Psychology (Ed D Buss):698-723. New Jersey, John Wiley & Sons.

MacWhinney B (2002) The gradual emergence of language. In The Evolution of Language Out of Pre-Language (Eds T Givon, BF Malle):231-263. Philadelphia, John Benjamins Publishing Company.

Mandler G (2007) A History of Modern Experimental Psychology. Massachusetts, MIT Press.

Miller G (1962) Some psychological studies of grammar. Am Psychol, 17:748-762.

Miller P (2008) Gelişim Psikolojisi Kuramları (Çev. Z Gültekin). Ankara, İmge Kitabevi.

Nehring A (1945) Plato and the theory of language. Tradition, 3:13-48.

Nerlich B, Clarke DD (2007). Cognitive linguistics and the history of linguistics. In The Oxford Handbook of Cognitive Linguistics (Eds D Geeraerts, H Cuyckens):589-607. Oxford, Oxford University Press.

Newmeyer FJ (1995). Noam Chomsky In Concise Encyclopedia of Philosophy of Language (Ed PV Lamarque):507-512. Exeter, Pergamon.

Özbek M (2007) Dünden Bugüne İnsan, 2nd ed. Ankara, İmge Kitabevi.

Pederson E (2007). Cognitive linguistics and linguistic relativity. In The Oxford Handbook of Cognitive Linguistics (Eds D Geeraerts, H Cuyckens):1012-1044. Oxford, Oxford University Press.

Peterson B (2009) Dilin evrimi. Bilim ve Teknik, 207:56-61.

Petrides M, Cadoret G, Mackey S (2005) Orofacial somatomotor responses in the macaque monkey homologue of Broca's area. Nature, 435:1235-1238.

Pinker S (1995) The Language Instinct: The New Science of Language and Mind. London, UK, Penguin UK.

Pinker S, Bloom P (1992) Natural language and natural selection. In The Adapted Mind: Evolutionary Psychology and The Generation of Culture (Eds JH Barkow, L Cosmides, J Tooby):451-493. New York, Oxford University Press.

Pinker S, Jackendoff R (2005) The faculty of language: What's special about it? Cognition, 95:201-236.

Rizzolatti G, Fadiga L, Gallese V, Fogassi L (1996). Premotor cortex and the recognition of motor actions. Cogn Brain Res, 3:131-141.

Rizzolatti G, Fogassi L, Gallese, V (2000) Cortical mechanisms subserving object grasping and action recognition: A new view of cortical motor functions. In The New Cognitive Neurosciences (Ed MS Gazzaniga):539-552. Cambridge, MA, MIT Press.

Rizzolatti G, Fogassi L, Gallese V (2001) Neurophysiological mechanisms underlying the understanding and imitation of action. Nat Rev Neurosci, 2:661-670.

Ross GM (1988) Hobbes and Descartes on the relation between language and consciousness. Synthese, 75:217-229.

Segalowitz N, Trofimovich P (2013) Second language processing. In The Routledge Handbook of Second Language Acquisition. (Eds SM Gass, A Mackey):197-210. New York, Routledge.

Sinha C (2007) Cognitive linguistics, psychology and cognitive science. In The Oxford Handbook of Cognitive Linguistics. (Eds D Geeraerts, H Cuyckens):1266-1294. Oxford, Oxford University Press.

Solso RL, Maclin MK, Maclin OH (2007) Bilişsel Psikoloji (Çev. A Ayçiçeği-Dinn). İstanbul, Bilge Kitabevi.

Spocter MA, Hopkins WD, Garrison AR, Bauernfeind AL, Stimpson CD, Hof PR, et al. (2010) Wernicke's area homologue in chimpanzees (Pan troglodytes) and its relation to the appearance of modern human language. Proc R Soc Lond B Biol Sci, 277:2165-2174.

Stringer C, Galway-Witham J (2017) On the origin of our species. Nature, 546:212-214.

Tallerman M, Gibson KR (2012) Introduction: the evolution of language. In The Oxford Handbook of Language Evolution (Eds M Tallerman, KR Gibson):1-35. Oxford, Oxford University Press.

Thomas A (2003) Augustine and signs (Masters thesis). Durham, Durham University.

Tomasello M (2007) Cognitive linguistics and first language acquisition. In The Oxford Handbook of Cognitive Linguistics (Eds D Geeraerts, H Cuyckens):1092-1112. Oxford, Oxford University Press.

Tooby J, Cosmides L (2005) Conceptual foundations of evolutionary psychology. In The Handbook of Evolutionary Psychology (Ed DM Buss):xxiii-xxv. New Jersey, John Wiley & Sons.

Whorf BL (2012) Language, Thought, and Reality: Selected Writings of Benjamin Lee Whorf, 2nd ed. (Eds JB Carroll, SC Levinson, P Lee). New York, John Wiley.

Zola-Morgan S (1995) Localization of brain function: The legacy of Franz Joseph Gall (1758-1828). Annu Rev Neurosci, 18:359-383.

Authors Contributions: The author(s) has declared that she has made a significant scientific contribution to the study and has assisted in the preparation or revision of the manuscript
Peer-review: Externally peer-reviewed.
Conflict of Interest: No conflict of interest was declared.
Financial Disclosure: No financial support was declared for this study.